# The Auk

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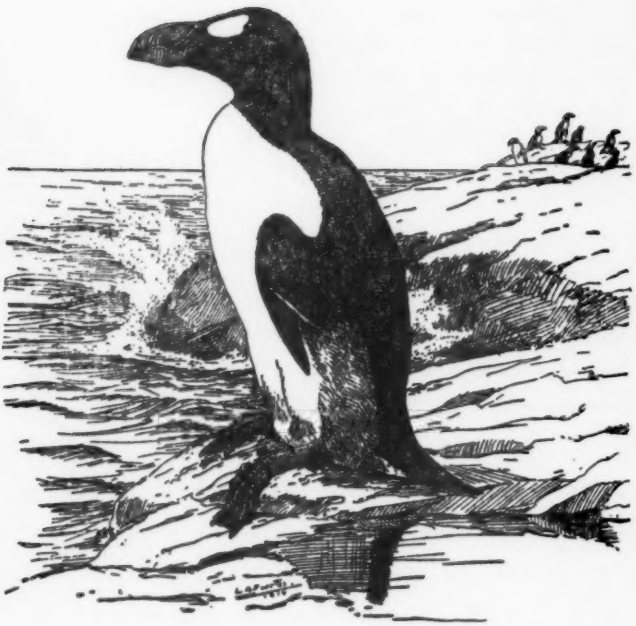

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## CONTENTS


THE WHITE-EARED PUFFBIRD. *Don R. Eckelberry* ..... 1

EVOLUTIONARY RELATIONSHIPS AMONG THE NORTH AMERICAN MALLARDS. *Paul A. Johnsgard* ..... 3

REVISED LIST OF THE BIRDS OF THE COMMANDER ISLANDS. *Hans Johansen* ..... 44

LIST OF AND NOTES ON THE BIRDS OF THE ILES DES SAINTES, FRENCH WEST INDIES. *Charles Vaurie* ..... 57

WINTER FEEDING PATTERNS IN THE HOUSE SPARROW. *James R. Beer* ..... 63

ECOLOGICAL ASPECTS OF THE BLUE-SNOW GOOSE COMPLEX. *Graham Cooch* ..... 72

GENERAL NOTES

**Observations on Pellet-Casting by Horned and Pied-billed Grebes.** *Robert W. Storer* 90

**The Kestrel *(Falco tinnunculus)* in the New World.** *R. Pinchon and Charles Vaurie*.... 92

**Three Further Records of Parasitic Egg Laying by Ducks.** *Lloyd B. Keith*..... 93

**Night Migration at 4,200 Meters in Venezuela.** *William H. Phelps*..... 93

**Natural Longevity Record for a Bobwhite.** *Halsey M. Marsden*..... 94

**Additions to the Guatemalan Bird List.** *Hugh C. Land and Larry L. Wolf*..... 94

**A Subspecies of *Torreornis inexpectata* from Cuba.** *Matthew J. Spence and Barton L. Smith* ..... 95

**Unusual Feeding Habit of Boat-tailed Grackle.** *Charles E. Carter*..... 97

**First Blue Grosbeak Collected in Ontario.** *James Woodford and D. H. Baldwin*..... 97

**Duetting by Paired Brown-headed Cowbirds.** *Hervey Brackbill*..... 97

**Shadow Boxing by Brown-headed Cowbirds.** *Hervey Brackbill*..... 98

**The Caracara Nesting in Arizona.** *Seymour H. Levy*..... 99

**Albinism in the Small White-Cheeked Geese.** *Richard E. Marquardt*..... 99

REVIEWS ..... 101

RECENT LITERATURE. Edited by *Frank McKinney* ..... 109

NOTES AND NEWS ..... 122

CORRESPONDENCE ..... 123

OBITUARY ..... 123


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WHITE-EARED PUFFBIRD, life-size, from a field painting in watercolor by Don R. Eckelberry.

# THE AUK

A QUARTERLY JOURNAL OF

**ORNITHOLOGY**

VOL. 78 JANUARY, 1961 NO. 1


## THE WHITE-EARED PUFFBIRD


DON R. ECKELBERRY


THE White-eared Puffbird *(Nystalus chacuru)* reaches Argentina only in the tropical northeastern Province of Misiones, where I observed and painted it. The species occurs also in Paraguay, Bolivia, and eastern Peru, with the bulk of its range in Brazil. In Misiones I encountered White-eared Puffbirds on some of those occasional provisioning trips, which brought us out of the forest where we were camped. Although arboreal, these birds appear to prefer the clearings. Indeed, I first saw a pair in a spreading tree along a village street. The birds seemed little concerned about the human activity around them, although they were entirely exposed on the bare branches that had not in mid-August begun to leaf. They were silent and characteristically sedentary, scarcely moving until finally one shifted to another branch and the other followed at a little distance. The sexes are alike.

A Guarani hunter brought a fresh specimen into camp late on the afternoon of 2 September 1959, and I seized the opportunity to make this portrait. At that season and at that elevation (about 500 meters), the nights can be surprisingly cold, and darkness comes suddenly. So the last strokes were added with chilled fingers and with the aid of a gas lantern, the lantern not only for light but for heat over which I could "toast" the washes of color that refused to dry in the damp air.

These puffbirds do not always appear so lax-plumaged as shown here or as their name suggests. When their feathers are compressed, the body has a leaner look, and the head seems smaller and flatter crowned. In such states of "tension" they often lean forward on their perch until body, head, and tail are more or less in line, staring ahead with an intense expression that might be construed as either fierceness or myopia.

Another member of the genus to reach Argentina, *Nystalus maculatus*, is more widely distributed in the northwestern provinces, where, in my experience, it is a bird of deciduous scrub forest. It occurs also in

Brazil and Bolivia. A third member of the genus, *N. striolatus*, inhabits central and northeastern Brazil, Bolivia, and eastern Ecuador. The northernmost of the four, *N. radiatus*, ranges from Panama through Colombia to western Ecuador.

*Babylon, Long Island, New York.*

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Grateful acknowledgment is made to Don Eckelberry for permission to reproduce the original painting. Publication of the plate has been made possible by generous gifts from William H. Phelps and William H. Phelps, Jr.—ED.

# EVOLUTIONARY RELATIONSHIPS AMONG THE NORTH AMERICAN MALLARDS

PAUL A. JOHNSGARD

THIS study is the report of an attempt to understand the evolutionary relationships existing within a group of mallardlike ducks native to North America. The group includes the Common Mallard, *Anas platyrhynchos platyrhynchos* L.; the Black Duck, *Anas rubripes* Brewster; the Florida Duck, *Anas fulvigula fulvigula* Ridgway; the Mottled Duck, *Anas fulvigula maculosa* Sennett; the Mexican Duck, *Anas diazi diazi* Ridgway; and the New Mexican duck, *Anas diazi novimexicana* Huber. All but one of these (the Common Mallard) are restricted to North America, and all these American forms possess a sexually nondimorphic plumage. In all other respects they are extremely similar to the Common Mallard, and a study of their relationships to this form was believed possibly to provide an instructive example of speciation.

## REVIEW OF RANGES, POPULATIONS, AND NOMENCLATURE

### *The Mexican and New Mexican Ducks*

In 1886 Ridgway described a new species of mallard *(Anas diazi)* from Puebla, Mexico, which, similar to the then recently (1874) described Florida Duck, differed from the Common Mallard *(Anas platyrhynchos)* in its lack of sexual dimorphism. According to Ridgway, the new species differed from the Florida Duck in its more Mallardlike characteristics, namely the distinct band of white on the secondary wing coverts and its less-fulvous over-all coloration. Thirty-six years later, Huber (1920) described another species of mallard from New Mexico, which he named *Anas novimexicana*. Huber was seemingly unaware of the similarities shown by the New Mexican Duck to the Mexican Duck, but in 1922 Conover referred to an extralimital Nebraskan specimen as *Anas diazi novimexicana*, and Phillips (1924) treated the New Mexican Duck in the same manner in his monograph. Although the close relationship between the New Mexican and the Mexican ducks was therefore realized relatively early, the paucity of specimens and field observations made the exact geographic relationship between the two forms uncertain. In 1946 Lindsey summarized the situation as follows: "The known nesting range of the New Mexican Duck is confined to a small area of the south-western United States, but the presumptive range extends southwards into Chihuahua, Mexico, where its relation to the northern breeding limits of the Mexican Duck *(A. diazi diazi)* is undetermined."

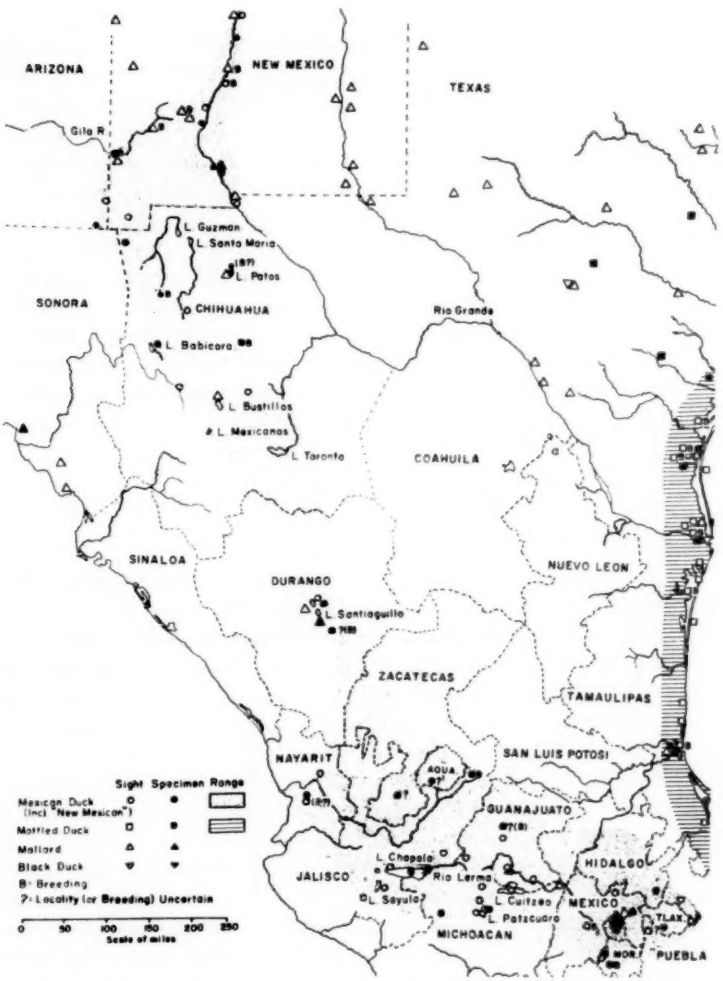


**Figure 1. Geographic range of Mexican (including "New Mexican") Duck.**

An attempt has been made to map the geographic ranges of the Mexican and New Mexican ducks, and thus to help visualize their geographic relationships. This was done by plotting all available specimen records and such sight records as appeared justified from the literature, personal communications, and the major United States collections. The

resulting map (Figure 1) shows fairly close agreement with the comparable maps of Delacour (1956), Arellano and Rojas (1956), and Leopold (1959). It follows the map of Leopold in indicating an unbroken range between the New Mexican and Mexican populations, although records are spotty for the area in question. If birds at the northern parts of the range are migratory, for which there is some evidence, it is probable that they winter in the heart of the range of *diazi;* habitat conditions are very poor on the Chihuahua lakes, and they are unattractive to waterfowl (Saunders and Saunders, 1949).

Of all the races of North American mallards, perhaps least is known about the Mexican Duck, and this is certainly the case regarding the total population size. Since 1947 the U.S. Fish and Wildlife Service has surveyed the lakes of interior Mexico during its annual January waterfowl inventories. Mr. R. H. Smith, who has flown this route each year since 1951, has provided *(in litt.)* the data obtained for the Mexican Duck during these years. The smallest total number of Mexican Ducks recorded was 780 in 1951, and the largest total was 10,322 in 1958. Although the northern Chihuahuan lakes—Toronto, Bustillos, and Mexicanos—were surveyed, it is of interest that no Mexican Ducks have been recorded there; Lago Santiaguillo, Durango, is apparently the northern wintering limit of the Mexican Duck in Mexico. Its western limit would appear to be Lago Sayula, Jalisco, and the eastern limit in the marshy region near Oriental, Puebla. These data would indicate that the size of the adult Mexican Duck population is probably less than 20,000 birds. New Mexican game biologists have estimated that the population in their state is extremely small, possibly not over 100 adult birds.

*The Florida and Mottled Ducks*

In 1874 Ridgway described a new form of mallard from St. Johns, Florida, which he considered to be a subspecies of the Black Duck. As the Black Duck was at that time called *Anas obscura,* the new bird was named *Anas obscura* var. *fulvigula.* It differed mainly from the Black Duck in that the malar region, chin, and throat were immaculate buff rather than streaked with dusky, and the plumage had a general ochraceous, rather than dusky, tone. At the time it was known only from Florida. Later (1878) Ridgway relegated it to the rank of a full species, *Anas fulvigula.* Eleven years later, Sennett (1889) described from Texas yet another species of mallard, which he called *Anas maculosa.* Sennett stated that the most marked differences between *A. fulvigula* and *A. maculosa* were the latter's streaked, rather than plain buff, cheeks and a green, rather than purple, speculum in addition to a mottled, rather than streaked, general coloration. The Mottled Duck

was added to the A.O.U. *Check-list* in 1890 as *Anas fulvigula maculosa*, and no later arguments for retaining the specific status of *maculosa* have been presented.

Although Phillips had vacillated earlier between accepting and rejecting the Mottled Duck and Florida Duck as distinct races, in 1924 he synonymized the two forms. Later, Peters (1931) accepted *maculosa* as being distinct from *fulvigula*, although Delacour and Mayr (1945) as well as Hellmayr and Conover (1948) synonymized them. The form *maculosa* is still accepted by the A.O.U. *Check-list*.

Regardless of the question of the validity of the described plumage differences, which will be discussed later, a definite hiatus in the ranges of the populations seems to exist. The range of the Florida Duck (see Figure 2, which is modified from Howell, 1932, and Sprunt, 1954) is largely confined to the southern half of peninsular Florida, with its northern limits being in the vicinity of Gainesville. There are apparently no specimens of *fulvigula* or *maculosa* that have been taken in Mississippi. A single specimen has been taken in Alabama (Imhof, 1958) and may represent either *fulvigula* or *maculosa*. In addition, several sight records along the coast of Alabama have been obtained for Florida or Mottled ducks. Mottled Ducks occur commonly almost to the eastern border of Louisiana (Oberholser, 1938). They are found mainly in the coastal tier of parishes of Louisiana (Lowery, 1955) west to the Texas border, and in Texas likewise follow the coastal counties for the entire length of the state (Singleton, 1953). The range of the Mottled Duck also extends a long distance into Mexico (Saunders, 1952, 1953) in the states of Tamaulipas and Veracruz. The range map presented in Figure 2 is a composite of information from the sources cited above, and from additional sight and specimen records available to me.

The Florida Game and Fresh Water Fish Commission has taken a census of the Florida Duck population annually since 1948 by the aerial transect method. During the years 1948 to 1955, the estimated total adult population varied from 17,000 to 30,000 (Sincock, 1957). The 1956 and 1957 inventory estimates for the entire state were 9,000–16,000 and 7,000–10,000 birds, respectively, indicating, according to Sincock, a sharp drop in Florida Duck numbers in recent years. A reasonable estimate of the present total adult Florida Duck population would appear to be 10,000.

In Louisiana, inventories of the Mottled Duck population have been made yearly since 1952. Estimates in recent years have averaged about 10,000 birds (M. M. Smith, *in litt.*), which are spread out fairly evenly over the marshes of southeast and southwest Louisiana, being especially

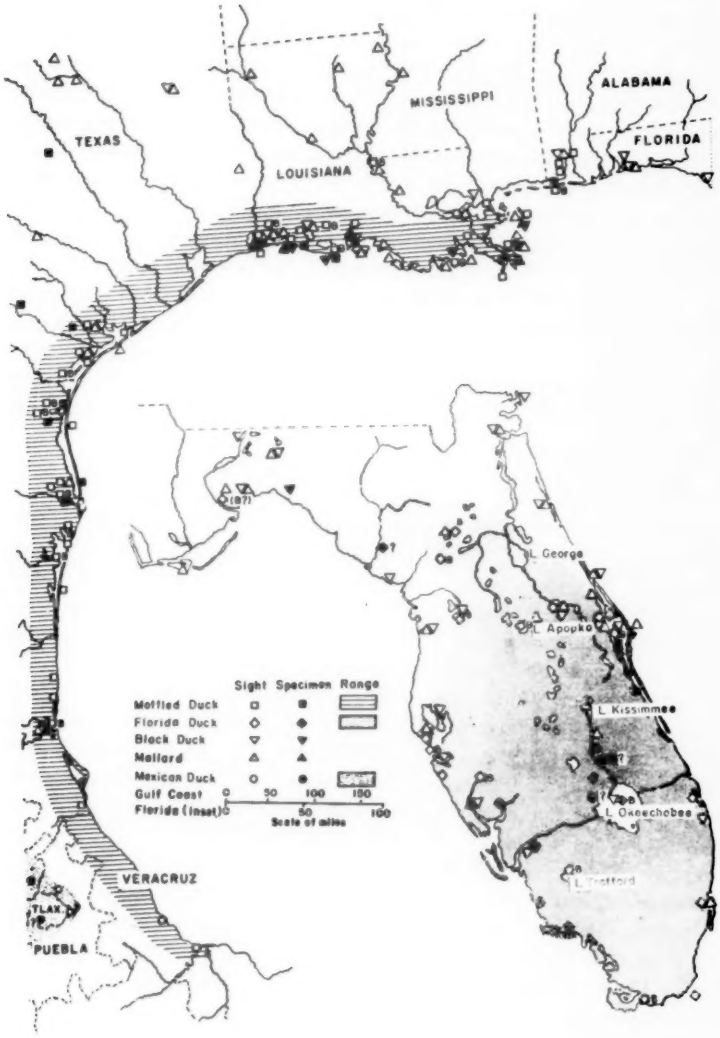


**Figure 2. Geographic ranges of Mottled and Florida ducks.**

frequent in the salt and brackish marshes of the coast. In Texas the coastal waterfowl surveys for the years 1947 to 1952 provide an estimate of winter Mottled Duck populations in that state (Singleton, 1953). Mottled Ducks during these five years averaged over 7,000 birds in October (maximum of 23,000 in 1947), decreasing monthly to an average minimum of from 1,000 to 2,000 birds from November through February. Estimated summer Mottled Duck populations over a 26,000-square-mile area were 18,500 in March and 21,000 in August 1952. These birds are distributed over the entire coastal prairie region, extending inland from 50 to 70, or possibly 100, miles (Singleton, 1953).

Little can be said regarding the size of the Mexican population of Mottled Ducks. Saunders (1953) reports that "several hundred" have been seen during the January inventories along the Mexican coast, and Saunders and Saunders (1949) state that ground studies in Tamaulipas and Veracruz indicated that several thousand birds are present. In summary, the total Mottled Duck population might be estimated at 30,000 adult birds in the United States plus an additional number, possibly not over 5,000, in Mexico.

*The Black Duck*

Gmelin described the American Black Duck in 1788 as *Anas obscura*, based on Pennant's "Dusky Duck" from New York. This name was used until 1908, when *Anas obscura* was found to be preoccupied (Allen, *et al.*, 1908). In 1902, however, Brewster had described a subspecies of the Black Duck, which he called *rubripes*, and thus this name was taken for the specific epithet to replace *obscura*. This left Brewster without a name for his newly described form, a condition he rectified in 1909 by proposing *tristis*. The ensuing arguments for (Brewster, 1910; Phillips, 1920; Townsend, 1912) and against (Dwight, 1919; Pirnie, 1928; Shortt, 1943) the admission of *tristis* have filled many pages, and the long-delayed acceptance (1931) of this form by the A.O.U. *Check-list* committee was withdrawn in 1945 following Shortt's (1943) careful analysis of seasonal variations in soft-part coloration. The present consensus that *tristis* is not an admissible form is followed here.

In 1945 Delacour and Mayr stated that "it seems obvious that the Mexican and Black Ducks are only sub-specifically distinct from the Dusky Duck" *(fulvigula)*, and consequently the Black Duck was treated in their revision as *Anas fulvigula rubripes*. However, in 1956 Delacour modified his opinion regarding the Mexican and Florida ("Dusky") ducks' affinities, stating that the latter will mate preferentially with the Common Mallard rather than the Black Duck, and so restored the name *Anas rubripes* to the Black Duck.

The recent treatise by Stewart (1958) on the distribution of the Black Duck is a thorough and detailed account that can scarcely be improved. His maps of the wintering and breeding ranges of the Black Duck agree well with the data collected during the present study, and are adopted in simplified form (Figure 3) here. Stewart divided the eastern United States into six regions of approximately equal size (indicated in Figure 5), and determined the average wintering Black Duck populations for each region, based on the annual January U.S. Fish and Wildlife Service inventories for the five years 1952–1956. These data, rounded to the nearest 1,000, appear in Table 1, together with the average percentage

**Figure 3. Southern limit of breeding (broken line) and wintering (shaded) ranges of Black Duck.**

TABLE 1

REGIONAL DISTRIBUTION OF WINTERING BLACK DUCKS

| *Region* | *Total Black Ducks* | *Birds/party hour* | *Per cent total* |
|---|---|---|---|
| East-Central | | | |
| U.S.F.W.S. counts | 128,000 | — | 19 |
| Christmas counts | — | 76.2 | 19.3 |
| Atlantic Coastal | | | |
| U.S.F.W.S. counts | 417,000 | — | 61 |
| Christmas counts | — | 239 | 60.7 |
| Southeastern | | | |
| U.S.F.W.S. counts | 62,000 | — | 9 |
| Christmas counts | — | 13.9 | 3.5 |
| Great Lakes | | | |
| U.S.F.W.S. counts | 32,000 | — | 5 |
| Christmas counts | — | 31.5 | 8.0 |
| Northern New England | | | |
| U.S.F.W.S. counts | 35,000 | — | 5 |
| Christmas counts | — | 32.5 | 8.2 |
| Western | | | |
| U.S.F.W.S. counts | 4,000 | — | 1 |
| Christmas counts | — | 0.9 | 0.2 |

of the total U.S. population observed in each region. In addition are included comparable data compiled from the annual Audubon Christmas counts for the years 1950–1957. Because the numbers of observers vary greatly in different areas, average total Black Ducks recorded per party hour (for all counts on which Black Ducks were observed) are listed, rather than average total numbers of Black Ducks seen. A breakdown of these data by states is also presented in Figure 4, providing a more detailed comparison of Black Duck wintering densities throughout the eastern states. These two sets of data, obtained by widely differing means, agree remarkably well in regard to the relative distribution of the total wintering population. The only area of poor agreement is in the southeastern states, where a difference of 5.5 per cent occurs. This difference is at least partly explained by the fact that in Florida and Louisiana the Fish and Wildlife inventories include Florida and Mottled ducks with Black Ducks, since they cannot be distinguished during aerial counts. This factor tends to exaggerate estimated Black Duck populations in these states.

Total numbers of Black Ducks estimated on these annual January inventories provide the best available indication of population size, although these survey data cannot be considered to be completely accurate estimates of actual numbers of wintering Black Ducks (Stewart,

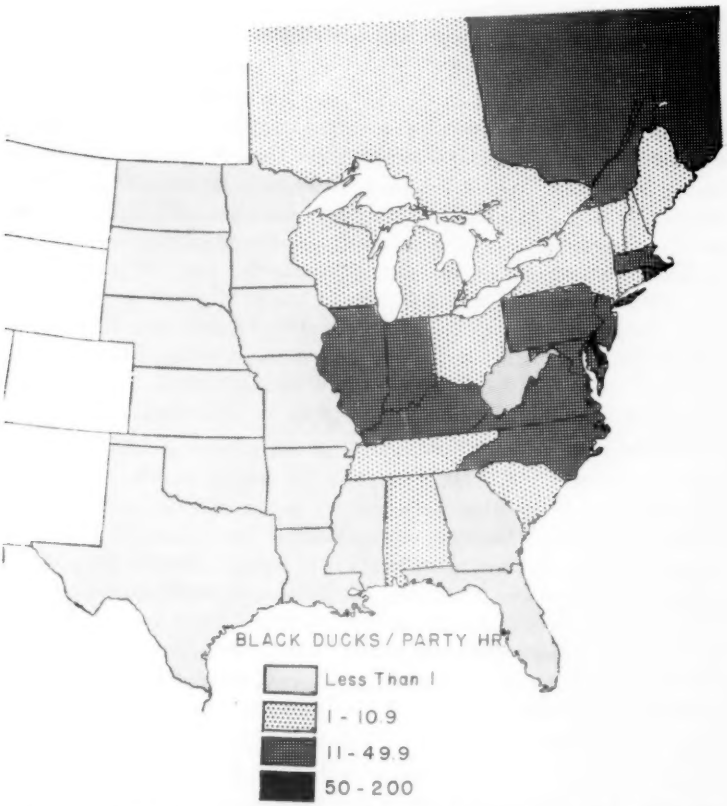


**Figure 4. Relative densities of wintering Black Ducks, eastern states.**

1958). During the five years included in Stewart's study, this average total population figure was approximately 678,000. If the 1957 and 1958 inventories are included, the seven-year average is 647,000 birds, which will be used here as an estimate of the total Black Duck population.

*The Common Mallard*

The Common, or Green-headed, Mallard was described by Linneaus in 1758 as *Anas platyrhynchos* in the 10th edition (p. 125) of his *Systema Naturae*. Previous to 1906, it was generally referred to as *Anas boschas*, before the page priority of *platyrhynchos* was established (Lönnberg, 1906). The species occurs throughout the northern hemisphere, and has

one of the widest breeding distributions of any species of waterfowl in the world.

Because of the rarity of this species in the eastern states during the colonial period, the Mallard (unless uncapitalized, the common name Mallard is used here to mean *A. p. platyrhynchos*) was not recognized as a common species in the United States, since it was replaced in the East by the Black Duck. Evidently it was not before the late 1800's that the Mallard began to move noticeably eastward, as indicated by the scarcity of references to it before 1900. Brewster (1906), referring to the Cambridge region, states: "During the earlier years of my shooting experience the Mallard was unknown to our local gunners, and everywhere throughout New England was considered a rare bird. Within the past decade, however, it has become a regular and not uncommon visitor in autumn to several localities in eastern Massachusetts. . . ." Townsend (1905) indicates a similar situation in the same region.

At present the Mallard must be considered a fairly numerous nesting species throughout the East, at least as far east as central New York. Although Maine probably may not yet be considered as within the nesting range of the Mallard, this species has been observed there with increasing frequency, and recently (1953) Coulter provided the first two definite nesting records for that state. At present Mallards and Mallard x Black Duck hybrids comprise approximately 1 per cent of the fall hunter kill in Maine (Coulter, 1954). In Ontario Mallards have increased greatly around the Toronto area (Goodwin, 1956), and to the north nest as far east as the James Bay region (Manning, 1952).

For the purposes of comparison with the Black Duck, a map showing the breeding and wintering distribution of the Mallard in the eastern states has been prepared (Figure 5). The breeding range has been modified from previous range maps (Kortright, 1942; Phillips, 1924) to show the eastern extension of the breeding range, and the winter distribution is based mainly on an analysis of the Audubon Christmas count data. Local areas of winter concentration are indicated. To provide an additional comparison with the Black Duck (Figure 4), the average total Mallards recorded per party hour (for all counts where Mallards were seen) have been calculated for each state for the period 1950–1957, and these data are presented in Figure 6.

Because only that portion of the Mallard population that is sympatric with the Black Duck is of biological importance from the practical standpoint of actual interaction between the two gene pools, only an estimate of the Mallard populations of the eastern states (Mississippi and Atlantic

flyways) will be attempted. It should be remembered, however, that the potential gene pool of the Mallard, if the Central and Pacific flyway (plus European and Asian) populations are considered, is actually immensely greater.

Again, the most satisfactory source of quantitative information on the size of Mallard populations is the Fish and Wildlife Service January inventories. For the Atlantic flyway, data from these counts are shown below for the 10-year-period 1949–1958, whereas for the Mississippi flyway they are available for the nine-year-period 1950–1958.

| | *Average total Mallards* | *Average total Black Ducks* | *Ratio Mallard: Black* |
|---|---|---|---|
| Atlantic flyway | 218,000 | 457,000 | 32.2:67.8 |
| Mississippi flyway | 3,566,000 | 190,000 | 97.5: 2.5 |
| Total eastern U.S. | 3,784,000 | 647,000 | 85.4:14.6 |

A check on the accuracy of these data is provided by a similar calculation of Mallards and Black Ducks observed per party hour during the Audubon Christmas counts over essentially the same period of years (1950–1957). Although actual numerical comparisons cannot be made, it is possible to obtain an index to relative densities of Mallards and Black Ducks by summing the average numbers of both forms recorded per party hour for all states within each flyway and obtaining ratios on the relative abundance of the two forms:

| | *Cumulative Mallards per party hour* | *Cumulative Black Ducks per party hour* | *Ratio Mallard: Black* |
|---|---|---|---|
| Atlantic flyway | 113.27 | 297.09 | 27.6:72.4 |
| Mississippi flyway | 2,259.06 | 97.14 | 95.9: 4.1 |
| Total eastern U.S. | 2,327.33 | 394.23 | 85.5:14.5 |

These two sets of data show extremely close agreement with one another, particularly in regard to the estimated ratio of Mallards to Black Ducks for the two flyways combined, where a disagreement of less than 1 per cent is found. It seems safe, therefore, to state that in the eastern United States the Mallard population outnumbers the Black Duck at the present time by approximately six to one.

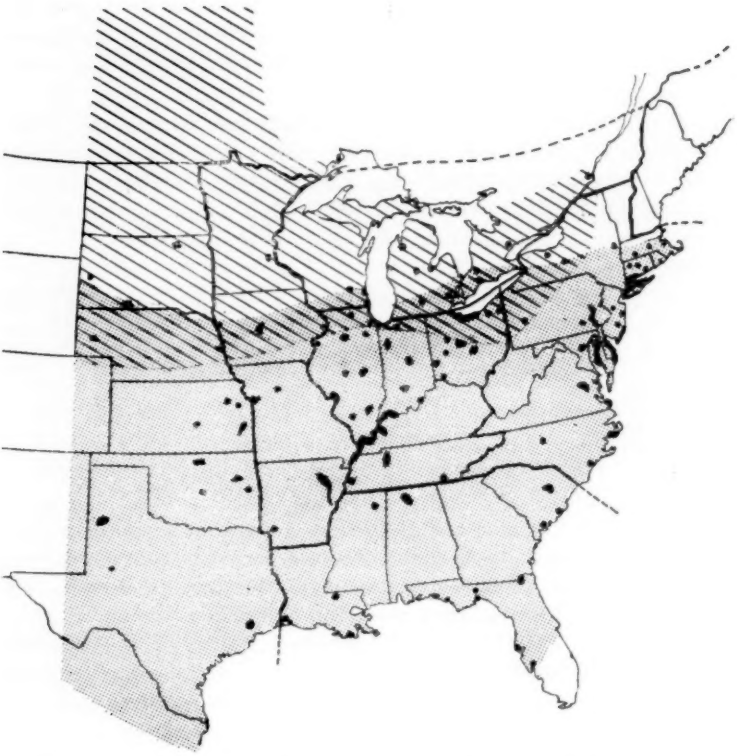

**Figure 5. Breeding (ruled lines) and wintering (shaded) ranges of Common Mallard in eastern states. Blacked-in areas indicate major wintering concentrations.**

## MORPHOLOGICAL CHARACTERISTICS

The various plumage and soft-part differences attributed to each of the sexually nondimorphic forms can be summarized as follows:

*The Mexican and New Mexican ducks.* According to Ridgway (1886), the Mexican Duck is most like the Florida Duck, differing in its double band of white on the wings, its less-fulvous coloration, its streaked cheeks, and in its lack of a black spot on the base of the maxilla. From the Mallard it differs in its obvious lack of sexual dimorphism. When Huber (1920) described the New Mexican Duck, no comparisons with other mallards were made, other than to say that it is apparently "a member of the Black Duck group."

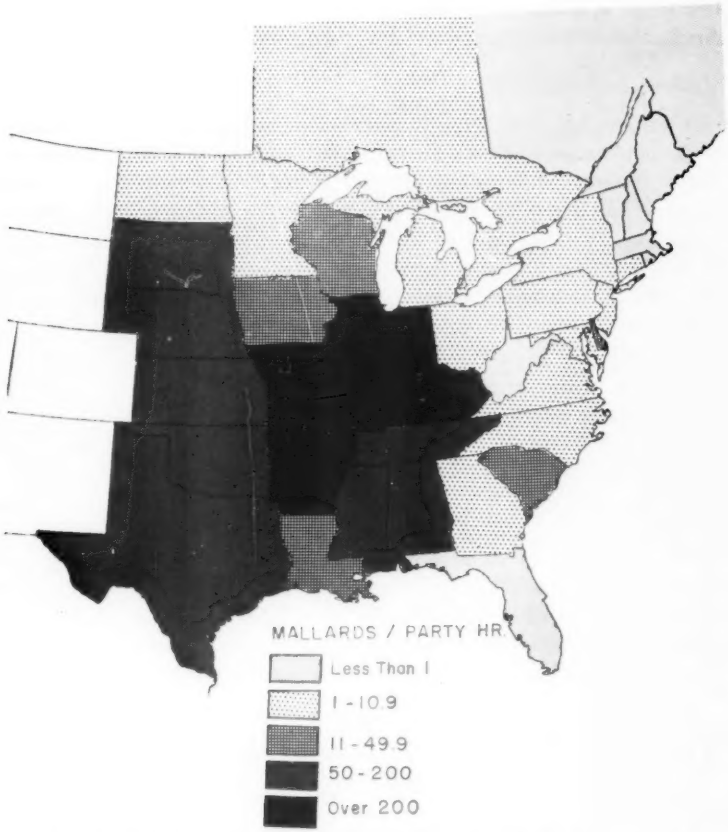


**Figure 6. Relative densities of wintering Common Mallards, eastern states.**

*The Florida and Mottled ducks.* The Florida Duck was stated (Ridgway, 1874) to differ from the Black Duck in the former's paler coloration, unmarked cheeks and throat, predominately ochraceous plumage tone, and (in males) a black spot at the base of the maxilla. The later description of the Mottled Duck, with its streaked cheeks, darker coloration, and less-distinct black mark on the maxilla, weakened these distinctions and left no clear-cut difference between these forms and the Black Duck.

*The Black Duck.* According to Kortright (1942), the Black Duck differs from the Mottled Duck by the former's olive-colored bill and the

absence of a black spot at its base, by possessing a distinctly streaked throat, and by having narrower buffy edges to the feathers of the back.

*Methods and Materials*

It was evident from the confusion indicated above that a comparative study of plumage and soft-part differences among these forms must primarily include measures of variation of the relative darkness of body plumage, the degree of white barring on the secondary coverts, and bill coloration. Various supposed differences in speculum coloration (shown by Phillips, 1912, to be highly variable) and the degree of streaking on the throat, which appears to be related to the relative darkness of the body plumage, were not considered of major importance for study.

It was decided at the outset that any plumage comparisons would have to be made with reference to a standard that would extend over a range including both extremes as well as graded intermediate conditions. The "Hybrid index" system, which has been so successfully used by Anderson (1949), Sibley (1950), and others for estimating objectively phenotypical variations, seemed of possible application here. It was discovered that the plumages of female hybrid combinations between Mallards and Black Ducks corresponded so closely to those of pure Mexican, Florida, and Mottled ducks that patterns of corresponding feather regions could be considered identical. Therefore, it was decided to use pure female Mallards and Black Ducks for plumage extreme standards, and graded hybrid combinations for the intermediate conditions.

Applying the technique of the Hybrid index, the extreme represented by the lightest plumage condition was given a numerical value of "0," and the darkest extreme was given a value of "4." The intermediate condition thus had a value of "2," and the 1/4 and 3/4 conditions had values of "1" and "3." In theory, an index number of "2" would result from an $F_1$ hybrid, and scores of "1" and "3" would be obtained from the two backcross combinations if no dominance were involved. Of course, wild-taken hybrids cannot be definitely established as such combinations, and in most cases probably would be the result of more complicated recombinations and segregations. However, by direct comparison with specimens in the Museum of Comparative Zoology at Harvard of known-parentage hybrids between Mallards and Black Ducks obtained from experimental breedings by Phillips (1915, 1921), it was possible to determine that no dominance was involved. Feathers from wild-taken hybrids from the Ithaca region, which closely corresponded to these known-parentage birds, were used as reference types.

Six feather areas, which included the major points of plumage differences mentioned above, were selected for study. These areas were as follows:

Outer (6th) Rectrices (Row "A," Figs. 7-9): Predominantly white in *platyrhynchos*, solid dusky in *rubripes*.

Scapulars (Row "B," Figs. 7-9): Wide terminal edge and three subterminal buff bars in *platyrhynchos*, narrow terminal edge and no barring in *rubripes*.

Flanks (Row "C," Figs. 7-9): Wide terminal edge and subterminal "V" in *platyrhynchos*, narrow terminal edge in *rubripes*.

Secondary Coverts (Row "D," Figs. 7-9): Broad white subterminal bar in *platyrhynchos*, this absent or very faint in *rubripes*.

Under-tail Coverts (Row "E," Figs. 7-9): Predominantly white in *platyrhynchos*, dusky with narrow buff edge in *rubripes*.

Breast (Row "F," Figs. 7-9): Predominantly white with brown spots or crescent in *platyrhynchos*, dusky, usually with faint "V" and narrow buff edge in *rubripes*.

Representative feathers from these areas are shown in Figure 7, with pure female Mallard ("0") at extreme left and pure female Black Duck ("4") at extreme right. This figure was used when determining index values of all females examined. Since the specimens from the populations other than *platyrhynchos* and *rubripes* were obviously not hybrids, perhaps "Plumage index" rather than "Hybrid index" would be a more appropriate designation for the method as it was used here.

A valid comparison of males from all forms was impossible, owing to the sexual dimorphism present in the Mallard. For visual comparison only, the corresponding feathers from males of the Mallard, the Black Duck, and hybrid combinations that probably closely approach the typical $F_1$ and the two backcross combinations are presented in Figure 8. The blending type of inheritance, as well as a curious appearance of female characteristics in some of the hybrid feathers (*e.g.*, flanks and rectrices), is of general interest.

To provide a means of objective evaluation of plumage differences in males, it was necessary to exclude the Mallard and devise a plumage index for the sexually nondimorphic forms only. This was accomplished by selecting feathers from males representing the lightest *(diazi)* and darkest *(rubripes)* extremes, and three graded conditions between them. The feather areas used were the same as in the females, and indeed the descriptions given for these feathers from the females apply equally well to the males. The index scoring was thus as follows:

| *Index No.* | *Plumage condition* |
|---|---|
| "0" | Lightest, as in *diazi*, with wide buff and white areas |
| "1" | Mainly as in *diazi*, but reduced buff and white areas |
| "2" | Intermediate between *diazi* and *rubripes* |
| "3" | Mainly as in *rubripes*, but with slight barring present |
| "4" | Darkest, as in *rubripes*, with no barring present |

**Figure 7. Reference chart of feathers from female Mallard (left), Black Duck (right), and hybrid combinations. Reading from top down, rows are *A* to *F* (in text).**

**Figure 8. Chart of feathers from male Mallard (left), Black Duck (right), and hybrid combinations. Reading from top down, rows are *A* to *F* (in text).**

**Figure 9. Reference chart of feathers from male Mexican Duck (left), Black Duck (right), and intermediate conditions. Reading from top down, rows are *A* to *F* (in text).**

These conditions are illustrated in Figure 9, the reference feather chart, with the left extreme representing "0" and the right extreme representing "4." In the case of both males and females, specimens that scored "0" for all six characters would receive a summed score of "0," whereas those that scored "4" for all characters would receive a summed score of "24."

*Results*

Index scores obtained for each feather region of all males and females examined are presented in Tables 2 and 3. By totaling the number of observations for each index class in a given form, a combined estimate of that form's relative darkness may be obtained, which can be compared statistically with the estimate of any other form. These combined observations and a mean index value for each form are also tabulated in Tables 2 and 3. By constructing a contingency table and determining the chi square values for any two populations in question, the probable validity of separating those populations on a plumage basis may be determined. Using the index data for females, *novimexicana* was compared with *diazi*, and *fulvigula* was compared with *maculosa*. Too few male specimens of *diazi* and *novimexicana* were available for a similar comparison, but male specimens of *fulvigula* and *maculosa* were sufficient for testing. In the case of female *novimexicana* and *diazi*, no strong indication of distinctiveness ($p > 0.05$) between the two populations was found. However, in the case of both male and female specimens of *fulvigula* and *maculosa*, separation of the two was distinctly indicated ($p < 0.01$).

An alternative means of presenting index data, that of summing indices for each specimen and plotting the summed totals for each form, is presented in Figures 10–11. In this case data from *novimexicana* and *diazi* were combined, since they showed no indication of summed index differences that might be significant. These diagrams clearly illustrate the difficulties of finding clear-cut morphological distinctions between any populations except the extremes. A fairly evident difference between *fulvigula* and *maculosa* may be seen in this diagram, and it is of interest that those specimens (four) of *maculosa* that achieved the highest summed indices were from Texas, primarily the Brownsville area, rather than from Louisiana. It would be of interest to learn if the Mexican population of *maculosa* also exhibits this very dark coloration, but at present almost no specimens have been collected from that region.

Examination of soft-part coloration is very difficult from preserved specimens, and as a result no critical studies were made of these features. However, since some aspects of bill spotting have been stressed by the authorities on these forms, an attempt was made to obtain some informa-

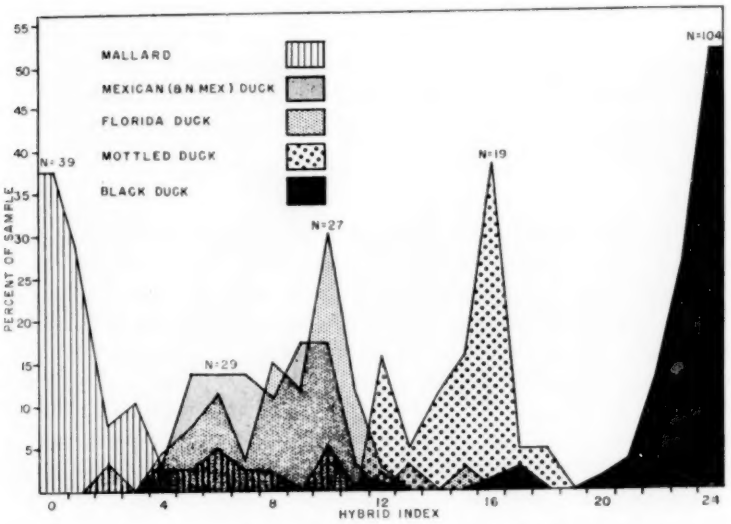


**Figure 10. Distribution frequencies of summed indices, female specimens.**

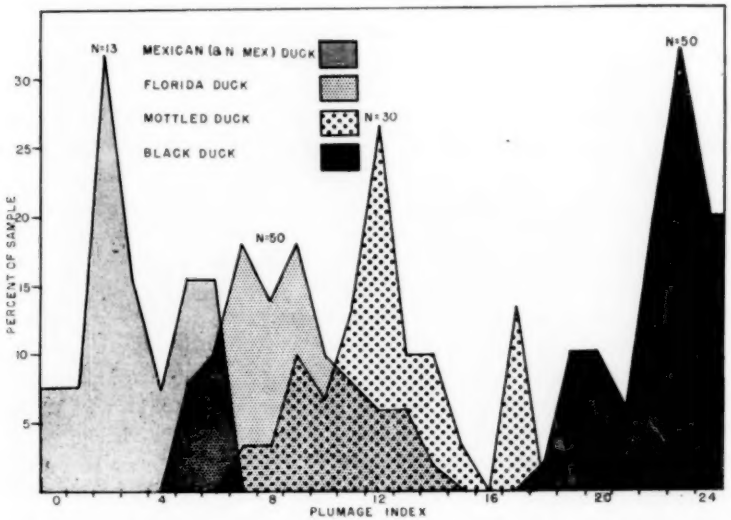


**Figure 11. Distribution frequences of summed indices, male specimens.**

TABLE 2

SUMMARY OF INDEX DATA FOR FEMALES

| | "0" | "1" | "2" | "3" | "4" | *Total specimens* |
|---|---|---|---|---|---|---|
| Rectrices | | | | | | |
| *platyrhynchos* | 30 | 5 | 4 | — | — | 39 |
| *novimexicana* | — | 10 | 6 | 1 | — | 17 |
| *diazi* | 1 | 7 | 4 | — | — | 12 |
| *fulvigula* | — | 11 | 13 | 3 | — | 27 |
| *maculosa* | — | 1 | 10 | 8 | — | 19 |
| *rubripes* | — | — | 1 | 8 | 95 | 104 |
| Scapulars | | | | | | |
| *platyrhynchos* | 18 | 13 | 8 | — | — | 39 |
| *novimexicana* | 1 | 4 | 8 | 4 | — | 17 |
| *diazi* | 2 | 2 | 7 | 1 | — | 12 |
| *fulvigula* | 2 | 16 | 9 | — | — | 27 |
| *maculosa* | — | 1 | 6 | 12 | — | 19 |
| *rubripes* | — | — | 1 | 9 | 94 | 104 |
| Flanks | | | | | | |
| *platyrhynchos* | 29 | 7 | 3 | — | — | 39 |
| *novimexicana* | 3 | 5 | 7 | 2 | — | 17 |
| *diazi* | 1 | 10 | 1 | — | — | 12 |
| *fulvigula* | 3 | 19 | 5 | — | — | 27 |
| *maculosa* | — | 2 | 11 | 6 | — | 19 |
| *rubripes* | — | — | 1 | 23 | 80 | 104 |
| Secondary coverts | | | | | | |
| *platyrhynchos* | 37 | 1 | 1 | — | — | 39 |
| *novimexicana* | — | 15 | 2 | — | — | 17 |
| *diazi* | 2 | 10 | — | — | — | 12 |
| *fulvigula* | — | 14 | 11 | 2 | — | 27 |
| *maculosa* | — | 2 | 11 | 6 | — | 19 |
| *rubripes* | — | — | 2 | 14 | 88 | 104 |
| Tail coverts | | | | | | |
| *platyrhynchos* | 29 | 7 | 3 | — | — | 39 |
| *novimexicana* | 1 | 12 | 4 | — | — | 17 |
| *diazi* | — | 10 | 2 | — | — | 12 |
| *fulvigula* | — | 11 | 12 | 4 | — | 27 |
| *maculosa* | — | — | 6 | 13 | — | 19 |
| *rubripes* | — | — | 1 | 15 | 88 | 104 |
| Breast | | | | | | |
| *platyrhynchos* | 30 | 6 | 3 | — | — | 39 |
| *novimexicana* | 1 | 13 | 3 | — | — | 17 |
| *diazi* | — | 10 | 2 | — | — | 12 |
| *fulvigula* | 2 | 8 | 16 | 1 | — | 27 |
| *maculosa* | — | — | 7 | 12 | — | 19 |
| *rubripes* | — | — | 3 | 20 | 81 | 104 |
| *Total combined character observations* | | | | | | *Index mean* |
| (*Six per specimen*) | | | | | | |
| *platyrhynchos* | 173 | 39 | 22 | — | — | 0.35 |
| *novimexicana* | 6 | 59 | 30 | 7 | — | 1.37 |
| *diazi* | 6 | 49 | 16 | 1 | — | 1.17 |
| *fulvigula* | 7 | 79 | 66 | 10 | 1 | 1.49 |
| *maculosa* | — | 6 | 51 | 57 | — | 2.45 |
| *rubripes* | — | — | 9 | 89 | 526 | 3.83 |

TABLE 3

SUMMARY OF INDEX DATA FOR MALES

| | *"0"* | *"1"* | *"2"* | *"3"* | *"4"* | *Total specimens* |
|---|---|---|---|---|---|---|
| Rectrices | | | | | | |
| *novimexicana* | 3 | 1 | — | — | — | 4 |
| *diazi* | 5 | 4 | — | — | — | 9 |
| *fulvigula* | — | 13 | 26 | 7 | 4 | 50 |
| *maculosa* | — | 1 | 11 | 15 | 3 | 30 |
| *rubripes* | — | — | — | 1 | 49 | 50 |
| Scapulars | | | | | | |
| *novimexicana* | 2 | — | 2 | — | — | 4 |
| *diazi* | 2 | 7 | — | — | — | 9 |
| *fulvigula* | 4 | 26 | 18 | 2 | — | 50 |
| *maculosa* | 2 | 5 | 16 | 7 | — | 30 |
| *rubripes* | — | — | — | 1 | 49 | 50 |
| Flanks | | | | | | |
| *novimexicana* | 3 | — | 1 | — | — | 4 |
| *diazi* | 7 | 2 | — | — | — | 9 |
| *fulvigula* | 15 | 31 | 4 | — | — | 50 |
| *maculosa* | — | 15 | 9 | 6 | — | 30 |
| *rubripes* | — | — | — | 15 | 35 | 50 |
| Secondary coverts | | | | | | |
| *novimexicana* | 3 | 1 | — | — | — | 4 |
| *diazi* | 6 | 3 | — | — | — | 9 |
| *fulvigula* | — | 26 | 23 | 1 | — | 50 |
| *maculosa* | — | 5 | 18 | 7 | — | 30 |
| *rubripes* | — | 1 | 10 | 17 | 22 | 50 |
| Tail coverts | | | | | | |
| *novimexicana* | 3 | 1 | — | — | — | 4 |
| *diazi* | 5 | 4 | — | — | — | 9 |
| *fulvigula* | — | 32 | 18 | — | — | 50 |
| *maculosa* | — | 13 | 17 | — | — | 30 |
| *rubripes* | — | — | 2 | 11 | 37 | 50 |
| Breast | | | | | | |
| *novimexicana* | 2 | 2 | — | — | — | 4 |
| *diazi* | 1 | 8 | — | — | — | 9 |
| *fulvigula* | — | 17 | 25 | 8 | — | 50 |
| *maculosa* | — | 1 | 20 | 9 | — | 30 |
| *rubripes* | — | — | 1 | 20 | 29 | 50 |
| *Total combined character observations (Six per specimen)* | | | | | | *Index mean* |
| *novimexicana* | 16 | 5 | 3 | — | — | 0.46 |
| *diazi* | 26 | 28 | — | — | — | 0.52 |
| *fulvigula* | 19 | 145 | 114 | 18 | 4 | 1.48 |
| *maculosa* | 2 | 40 | 91 | 44 | 3 | 2.03 |
| *rubripes* | — | 1 | 13 | 65 | 221 | 3.69 |

tion on these points. The major question concerns the presence or absence of a black spot on the base of the maxilla of males. Ridgway (in Ferrari-Perez, 1886) used this character to separate *fulvigula* (present) from *rubripes* (absent), and likewise Kortright (1942) indicates that it is absent in *rubripes*. However, Shortt's plate in Kortright's volume, as well as that in Shortt's (1943) paper of soft-part colors of

the Black Duck, shows this spot clearly. I have noted it on all live male Black Ducks in breeding condition that I have examined, but the olive-slate color of the rhamphotheca of preserved Black Duck specimens obscures this mark. It was also found to be present on all 17 of the male specimens of *fulvigula* and all 12 *maculosa* examined for it. It was absent from five male specimens of *diazi*, and thus appears to be typical of *fulvigula*, *maculosa*, and *rubripes*.

In summary it may be said that none of the described plumage or soft-part characters, aside from the sexual dimorphism of *platyrhynchos*, were found to be of absolute diagnostic value in differentiating any population from all other populations. It was found that the distinctive plumage characteristics of the two extremes, *platyrhynchos* and *rubripes*, are bridged by the other populations and exhibit the characteristics of these populations in hybrid individuals.

*The Genetic and Hormonal Basis of Sexual Dimorphism*

At this point, where it is apparent that the sexual dimorphism of the Common Mallard provides the only real qualitative morphological basis for distinction from the other populations, it is of prime importance to investigate the genetic basis for such dimorphism in order to ascertain the taxonomic "value" of this character. That is, are the genetic changes required for converting a highly sexually dimorphic phenotype to an essentially nondimorphic one so great that these phenotypes must be regarded as constituting two species? In all probability no one will ever be able to determine by how many genes one distinct species differs from another, but if it can be determined that the loss of sexual dimorphism is dependent upon only a very few genes, then the taxonomic value of such dimorphism must be considered slight.

It has been discovered that male Mallards can be "feminized" by orchidectomy, followed by the implantation of bits of ovarian material in the abdominal cavity (Goodale, 1918). Furthermore, the annual assumption of the "eclipse" plumage of the Mallard provides additional evidence that the male Mallard carries the genetic potentiality of female plumage patterns. However, such femalelike plumages can be obtained only during periods of little or no testicular activity, and thus would not provide an explanation for the permanently nondimorphic plumages of the forms concerned here. A genetic basis for the loss of sexual dimorphism in these forms is necessary, possibly similar to that found in some breeds of Domestic Fowl (*e.g.*, Sebrights). In such breeds both sexes are normally hen colored, and the factor producing hen coloration in males is determined by a single, dominant autosomal gene (Hutt, 1949), which, in the presence of either male or female hormone, acts

on the feather follicle and prevents the expression of male plumage. Gonadectomized birds, however, assume a more malelike plumage in the absence of sex hormones. Three female Black Ducks were ovariectomized during the present study, and plucked feather areas grew back normal feathers. Therefore it seems unlikely that the same mechanism that applies to the Domestic Fowl can be postulated for these ducks. However, it is most fortunate that experimental studies on the genetic nature of sexual dimorphism in the Mallard, Mottled Duck, and Black Duck have been conducted (Phillips, 1915, 1921), and these studies are so crucial to the evaluation of the genetic importance of sexual dimorphism in waterfowl that they will be summarized here in detail.

Phillips hybridized males of "Florida Duck" (actually Mottled Duck from Louisiana), Black Duck, Pintail *(Anas acuta)*, and Australian Gray Duck *(Anas poecilorhyncha superciliosa)* with female "Call Ducks" (domestic *Anas platyrhynchos)* of typical wild-type plumage. All of the crosses were extended to the $F_2$ generation, as well as to many of the backcross combinations. The results he obtained (1921) for the three, mallardlike forms were:

> Mallard x Florida Duck: 38 $F_2$ males obtained. Two nearly pure Mallard types, three nearly pure Florida types. Backcrosses to Mallard female bring out many pure Mallards.
>
> Mallard x Black Duck: 23 $F_2$ males obtained. Two most extreme Mallard variates lack solid green head, white neck-ring, and light-colored, vermiculated abdomen. Backcrosses to Mallard females show no pure Mallard types.
>
> Mallard x Australian Duck: 15 $F_2$ males obtained. Very slight segregation. Most extreme Mallard type scarcely differs from $F_1$ individuals. Backcross to Australian female was the only one made, so not directly comparable with the other backcrosses.

In the mating between the Mallard and the Pintail, "the smallest possible amount of segregation was found, both in the straight $F_2$ generation and in backcrosses with the Pintail male." Regarding the Mallard x "Florida" Duck crosses, Phillips (1921) states that the hybrids exhibit

> The most extreme example of segregation thus far discovered in species crosses between either ducks or pheasants. Parental types are almost recovered from among 38 $F_2$ males. Backcrosses to Mallard parent produce a more uniform generation of nearly pure Mallard types. The Florida Duck must be supposed to represent, from the genetic point of view, substantially a Mallard, with the male secondary sex characters not expressed.

He states further:

> It is apparent then that in this species cross we have a nearer approach to orthodox Mendelism than in any other thus far reported among birds. Out of 38 males two were nearly pure Mallard types, and three almost pure female types, these latter closely resembling the Florida Duck parent.

Although Phillips did not pursue this point, it should be stated that, according to the principle of multiple factor inheritance, a mating of two genotypes differing in a character by two pairs of independent, non-dominant genes would produce in an $F_2$ generation of 38 phenotypes an expected recovery of roughly four pure parental types (Sinnott *et al.*, 1950). Judging from Phillips' description, the $F_2$ generation of this cross closely approximated these expected results. It seems justified therefore to state that the difference in male plumages between the Common Mallard and the "Florida" (Mottled) Duck is probably explainable by a genetic difference of the magnitude of two gene pairs.

As indicated by Phillips, the Mallard x Black Duck $F_2$ generation exhibited less tendency toward segregation than the Mallard x Florida Duck cross, but more so than did the crosses involving the Australian Gray Duck and Pintail with Mallards. Thus we may conclude that the number of genes determining the Black Duck's plumage differences from the Mallard is greater than is the case with the Florida Duck, and fewer than the genetic differences between the plumages of the Mallard and the Australian Duck or Pintail. Phillips believed, however, that the Black Duck possesses the genetic capacity for assuming the male Mallard plumage. He states (1915):

> We are thus led to the belief that the wild Black Duck actually contains Mallard characters not present in the Australian Duck, and that these are slightly accentuated by association in the zygote with characters from the Mallard parent. In other words, there is present in the wild Black Duck, latent Mallard characters, which sometimes appear with age. These characters become immediately apparent when a quarter dose of Mallard is combined with a three-quarter dose of Black Duck.

It would seem apparent that the described plumage differences that have been the basis for the erection, at one time or another, of six species of North American mallards are scarcely valid characters on which to base species judgments. This is emphasized not only by the evidently slight genetic variations that can effect these differences, but also by the considerable individual variation and overlap of characters attributed to the various forms.

## Egg-White Proteins

### *Introduction and Methods*

In conjunction with Dr. C. G. Sibley's research on the electrophoretic characteristics of avian protein systems, an attempt was made to compare the egg-white proteins of as many of the forms under investigation as possible. The theoretical importance of protein similarities in determining phyletic relationships is now widely recognized. Comparative

studies utilizing electrophoresis are of relatively recent development; the history, methodology, and theoretical basis of these techniques have been summarized by Sibley (1960).

Comparative electrophoretic egg-white studies on waterfowl were begun by McCabe and Deutsch (1952), who analyzed 37 species of birds, including eight of waterfowl. Sibley (1960) has reported on several additional species of Anatidae, including some material from the Mallard and the Black Duck that has been used in the present study. Equipment and techniques utilized have been described in detail by Sibley and Johnsgard (1959a, 1959b).

*Variation with Anas*

To illustrate the amount of variation that is encountered among diverse species of *Anas (sensu* Delacour), samples from species representing the extreme morphological variation have been selected for presentation. These are the Common Pintail *(Anas acuta)*, Shoveler *(Anas clypeata)*, and Gadwall *(Anas strepera)*. Electrophoretic profiles of the egg-white proteins from these species are presented in Figure 12. These curves, projected on a centimeter scale, indicate the variability encountered in the stated sample size. Each of the samples was from a different egg. The uppermost of the three lines indicates the maximum vertical distance encountered in the combined profiles, the lowermost the minimum vertical distance, and the central line represents a mean profile sample, plotted optically, for each species. In all cases vertical variability is of least significance, relative height of the peak is of greater significance, and the horizontal mobility from the point of application (indicated by arrows) to each peak is of the greatest significance. Using the mean sample profiles of each species and superimposing them on the same chart provides an easy means of optical comparison. Thus it may be observed that the Gadwall possesses a higher peak in the ovoconalbumin region than do the other two species. The presumed ovomucoid and ovalbumin fractions of the Pintail have somewhat greater mobilities than have the corresponding fractions of the other species.

*Variation within the North American Mallards*

Within the mallard group, samples were obtained from the Mallard, the Florida Duck, and the Black Duck. These profiles are also presented in Figure 12. The Florida Duck profile was obtained from eight samples of a single, slightly incubated egg, whereas the others represent single samples from each of several fresh eggs. Therefore less credence can be placed in the results from the Florida Duck, and it is only included for the sake of completeness. The composite mean profiles from these

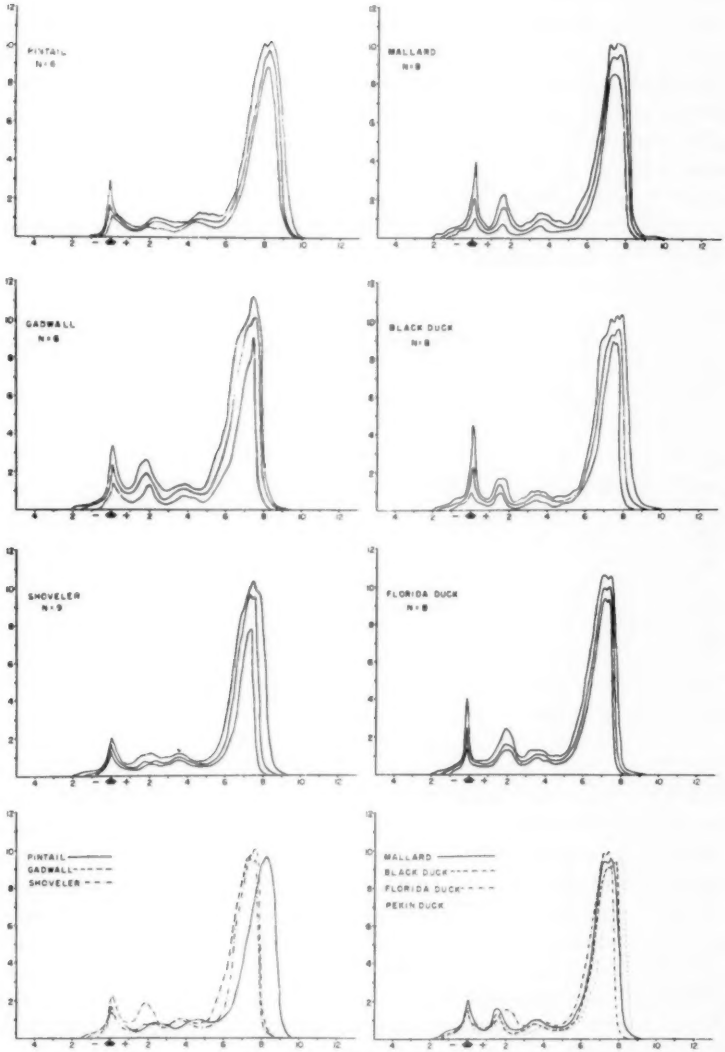


**Figure 12. Electrophoretic profiles of egg-white protein samples (see text for explanation).**

forms, plus domestic "Pekin" Mallard (*Anas platyrhynchos*), have been superimposed for easy comparison. It will be seen that the mean profiles of the Mallard and Black Duck are extremely similar, and in fact the Pekin profile exhibits greater difference from the wild form than does the Black Duck. Considering the inferior condition of the Florida Duck sample, it too shows a great similarity to the typical mallard profile, differing only in the mobility of the ovoconalbumin fraction. In the original profiles this fraction exhibited, by its indefinite and diffused borders, indications of having undergone partial chemical breakdown. It is very probable that fresh samples would show even closer similarity to the others.

## SEXUAL BEHAVIOR

Data on the sexual behavior of Mallards and Black Ducks have been presented elsewhere (Johnsgard, 1960), and will be summarized briefly here, together with notes on the behavior of the other forms concerned.

The behavior of the Mallard has been extensively studied by Lorenz (1941; 1951–1953) and more recently by Weidmann (1956) and others. These studies have all indicated that there are three major male "courtship" displays that are primarily concerned with pair formation. These are, in Lorenz's terminology, the "Grunt-whistle," the "Down-up," and the "Head-up-tail-up" with associated "Nod-swimming." The female's courtship displays consist primarily of "Nod-swimming" and "Inciting." These same displays are found, with varying degrees of modification, in all the mallardlike ducks as well as in other closely related groups of surface-feeding ducks, but in these less closely related species qualitative as well as quantitative differences occur in the behavior of both sexes.

A study of the courtship displays among wild and semiwild Mallards and Black Ducks, during which over 3,000 Mallard and over 1,300 Black Duck displays were tallied, has failed to reveal any qualitative differences in the male courtship displays of these two forms. Female courtship displays were not included in the quantitative studies owing to their nondiscrete nature, but no qualitative differences were observed between Mallards and Black Ducks in these female displays. Only a few statistically significant quantitative differences were detected in the male courtship displays of Mallards and Black Ducks. Of these, the most striking difference was that male Black Ducks have a lower display threshold; *i.e.*, in a given instance of male display more male Black Ducks are likely to display toward a female than would male Mallards in the same situation. It is suggested that this is a result of the Black Duck's absence of special male plumage characters, which likely intensify the need for a prompt and sensitive response to female signals. Secondly, male Black

Duck displays tended to be slightly more predictable and uniform than were male Mallard responses. This difference also was attributed to be the probable result of selection for specific male responses in the absence of male plumage differentiation.

A few observations on the behavior of Mallard x Black Duck hybrids were obtained for wild and captive individuals. Hybrids displayed with the same apparent intensity as did "pures" of each form, and also showed no deviation in qualitative features of display from the parental forms. All of the displays of the parental forms, including copulation, were observed in hybrids, but in too small numbers to submit to statistical analyses. Intermediate hybrids mingled with Mallard courting groups as frequently as with Black Ducks, although hybrids that were predominantly similar to one or the other parental form generally were found with the form they most resembled. Occasionally "pure" Mallards could be observed displaying in a group of Black Ducks or vice versa, but normally the courting groups of the two forms remained almost completely segregated.

No observations on the sexual behavior of the Mexican Duck were obtained, but captive specimens of the Florida Duck and Mottled Duck have been observed displaying. These observations are also too few to analyze statistically, but all the courtship displays of Mallards and Black Ducks have been observed in these races and in exactly the same situations and form as in Mallards and Black Ducks. Except for the slight plumage differences of all of the forms studied, it would be impossible to recognize whether a particular bird was a Mallard, a Florida Duck, a Mottled Duck, or a Black Duck on the basis of its sexual behavior.

## ISOLATING MECHANISMS

As shown earlier (Johnsgard, 1960), no qualitative differences in the behavior of male Mallards and Black Ducks were found that might serve as a basis for species recognition differences; indeed, no major quantitative differences were observed that might indicate a possible strengthening or diminution of any particular displays under the impact of selection against hybridization between the two forms. This means that, in a mixed population of unmated Mallards and Black Ducks, selective mating may otherwise be effected by (1) plumage differences in the males, (2) slight ecological or geographic distributional differences that would result in reduced probability of mixed pairing, or (3) differences in the temporal sequence of pair formation. The last-mentioned possibility may be ruled out on the basis of the behavioral studies cited above. The other points will be considered here.

Correct mate selection by females on the basis of male plumage differences is an obvious and simple means by which the two populations could be maintained as perfectly discrete and separate entities; male Black Ducks can be distinguished from male Mallards at great distances by even the unpracticed human eye. That such a discrimination might exist cannot be argued; that it actually does occur and so results in "correct" mate choices is worth investigation. If sexual selection in mallards is actually as important as is suggested by the elaborate male plumage pattern of the Common Mallard, it must be concluded that female Mallards tend to select for mate the more brightly colored birds. There is some evidence to support this theory (Johnsgard, 1960). One wonders then if female Black Ducks, confronted with both dull-colored drake Black Ducks and the comparatively "gaudy" male Mallards, might not tend to "choose" the brighter bird. Lorenz (1941) found that in the sexually nondimorphic Meller's Duck *(Anas melleri)* females showed as strong a tendency to mate with male Mallards as with their own species. This could possibly also be true of the Black Duck, which is so similar in outward appearance to the Meller's Duck. Goodwin (1956), in a stimulating discussion of this problem, has pointed out the rather obvious effects of mixed mating. He states: "If the ducks of either species are less selective with regard to cross-matings, then that species will tend to be less successful if a surplus of drakes exists." That there exists a preponderance of drakes in adult flocks of both Mallards and Black Ducks cannot be questioned. Most available data indicate that between 50 and 60 per cent of the combined sex populations of Mallards and Black Ducks are males. This means that not all males can be successful in obtaining mates, and the effectiveness of sexual selection is thus enhanced.

In comparing resident populations of Mallards and Black Ducks in the Toronto area, Goodwin (1956) noted that since the introduction of a small stock of Mallards and Black Ducks in 1931 the two forms have hybridized "fairly freely and yet Mallards have increased rapidly in proportion to Black Ducks." He suggests that a selection against Black Ducks such as postulated above might be operating through a tendency towards nonselective mating or towards cross-mating in the case of the Black Duck females. It would be most valuable to learn if most mixed pairing in the wild state involves male Mallards and female Black Ducks as would be expected, or, on the other hand, if female Mallards often mate with male Black Ducks. I have recorded or found reference to three pairings of the former type and six pairings of the latter kind, indicating that both combinations do occur, but the sample is far too small to suggest the favoring of either combination.

In spite of the essentially identical nature of the displays of Mallards and Black Ducks, there is a surprising amount of separation in courting groups between the two forms when they occur on the same water area. Whether this is the result of mutual attraction among like-plumaged birds or a result of very slight differences in habitat preference is difficult to decide. The marsh-dwelling tendencies of the Mallard, as opposed to the forest- and maritime-inhabiting proclivities of the Black Duck, are certainly the most conspicuous differences to be found between the two forms. This was well documented by Benson (1937) who investigated the breeding ecology of the Black Duck on some natural water areas near Ithaca, New York. One of these areas, Spencer Marsh, closely approaches the typical cattail and tule-bordered marshes found in the western prairie states, whereas the others, Danby Pond and the Michigan Hollow swamp and Beaver Pond, are typical representatives of the woodland ponds of the eastern states. The more alkaline cattail marsh was actually found to contain many more waterfowl-food plant species than the wooded ponds. However, in the wooded swamp and ponds Black Ducks usually nest every year, whereas in Spencer Marsh they had not been recorded as nesting. Benson concluded that the Black Duck "is apparently cognizant of the fact that it needs a background of shadows afforded by swamps, woods, and numerous logs and stumps," and "is not nearly so much at ease on Spencer Marsh as on the Beaver Pond and Danby Pond." In his book on the Black Duck, Wright (1954) has also pointed out that during the breeding season the bird is essentially a "forest duck." This contention is further supported by a breeding study done on Kent Island, Maryland, where 80 per cent of 161 Black Duck nests were found in wooded areas (Stotts, 1955). Although the Mallard will, under unusual circumstances, nest sometimes in heavily wooded areas (Bent, 1923), this is a comparatively rare situation.

## Estimation of Gene Pools and Hybridization Incidence

From the data presented earlier, it is possible to estimate with a fair degree of certainty the approximate sizes of the gene pools of the populations involved. By assigning the Mallard populations of the eastern United States (Atlantic and Mississippi flyways) an arbitrary value of 100, the relative estimated total population sizes of the other forms are as follows: Black Duck 17, Mottled Duck 0.91, Mexican Duck (including New Mexican population) 0.52, and Florida Duck 0.26. This clearly illustrates the comparatively small sizes of these southern populations and the ease by which they might theoretically be swamped. To determine how much, if any, interbreeding occurs among the sexually non-

dimorphic forms where they are in contact would be impossible. However, in the two areas where the Mallard overlaps in its breeding range with these nondimorphic forms the presence of hybridization is easily proved.

A relatively small amount of breeding contact exists between the Mallard and the Mexican ("New Mexican") Duck in central and southern New Mexico. In regard to the frequency of hybridization, Lindsey (1946) states:

> The extreme southern part of the Mallard's breeding range covers most of the known nesting range of the New Mexican Duck; frequent hybridization produces individuals showing widely varying proportions of the traits of the parental species. Almost any day in winter and early spring, interesting wild hybrids may be seen at close range, mingling with wild Mallards which also winter in the duck ponds at Rio Grande Park, Albuquerque. Hybrids usually outnumber the pure New Mexicans here; few of the latter winter this far north.

Except for this statement, no other estimate of hybridization incidence for the area is available.

It is somewhat easier to estimate the incidence of hybridization occurring between the Mallard and the Black Duck in the eastern United States, for the area of contact is much broader and a considerable amount of banding and hunter-kill data are available. No one has thus far accumulated such data with the intention of determining the exact hybridization incidence in any area, and these figures generally result from the occasional occurrence of a bird that cannot be readily classified as either a Mallard or Black Duck. Undoubtedly the great majority of recombinant individuals that only show slight deviations from the typical Mallard or Black Duck plumage patterns are not recorded as hybrids; juveniles, females, and males in nonbreeding plumage are also likely to be overlooked. However, to provide a very minimum estimate of hybridization incidence, an attempt was made to accumulate such data from a number of states. These data have been obtained primarily by directly contacting persons engaged in banding operations, as practically none of this kind of information has been published, and their assistance in compiling these figures is gratefully acknowledged. The most satisfactory data obtained in this way, from the standpoint of sample size (a minimum of 4,000 total birds), are presented in Table 4.

Nearly all of the persons contacted indicated that their figures only represented "obvious," or "pronounced," hybrids. Thus D. Handley, who provided the data from Ohio, states: "If minor hybrid characteristics were considered then the Mallard-Black hybrids would make up about five to ten per cent of the total Mallard and Black Duck populations." This would mean that the hybrid figures in this case should be

TABLE 4

MINIMUM MALLARD X BLACK DUCK HYBRIDIZATION INCIDENCE, VARIOUS STATES

| *State* | *Period* | *No. Mallards* | *No. Blacks* | *No. hybrids* | *Per cent hybrids* | *Per cent Mallards* | *Per cent hybrids / Blacks* |
|---|---|---|---|---|---|---|---|
| Ohio | 1950–1953 | 2,834 | 1,118 | 69 | 1.7 | 70.5 | 6.2 |
| Delaware | 1951–1958 | 2,160 | 2,489 | 74 | 1.5 | 42.5 | 2.5 |
| Michigan | 1935–1958 | 3,563 | 6,955 | 92 | 0.9 | 33.9 | 1.3 |
| Vermont | 1946–1957 | 335 | 3,647 | 19 | 0.5 | 8.4 | 0.5 |
| Pennsylvania | 1948–1958 | 1,957 | 8,531 | 25 | 0.2 | 18.6 | 0.3 |
| Maine | 1948–1957 | 423 | 23,907 | 39 | 0.2 | 1.9 | 0.2 |

multiplied by a correction factor of from between three to six, and the same can probably be safely stated for the other figures. Except for the data from Pennsylvania, there is a direct correlation between the percentage of recorded hybrids and the percentage of Mallards in the combined population. This might be interpreted to mean that a female Black Duck is more likely to mate with a Mallard where Mallards predominate than a female Mallard is likely to mate with a Black Duck where the latter predominate. It might, however, also simply mean that hybrids are more frequent where the two forms have been in contact longest, that is, in the western part of the Black Duck's range. In any event, it can be safely concluded that increased sympatry of range is likely to result in increased hybridization.

Unfortunately, no detailed data from the westernmost edge of the Black Duck's range could be located. Dr. W. H. Elder informed me (pers. comm.) that during his banding operations in Illinois Mallards comprised about 90 per cent of the combined Mallard and Black Duck catch, and that the ratio of Black Ducks to hybrids was approximately ten to one (about 700 to 70). Dividing this figure by two, there still remains at least 5 per cent of the Black Duck gene pool "tied up" in hybrids in that area.

No direct evidence that hybrids possibly are being selected against, either through reduced fertility or reduced ability to obtain mates because of intermediate characteristics, was obtained during this study or has been indicated by other studies. The complete spectrum of plumage variations from pure Mallard to pure Black Duck indicates that a sufficient number of hybrid matings occur to allow the phenotypic expression of every possible genetic recombination. For example the following numbers of wild male hybrids were observed at Howland's Island, New York, during a two-month period. Six almost pure Mallards, six predominantly Mallard, seven intermediate, eleven predominantly Black Duck, and eight almost pure Black Duck. If, however, hybrids actually are

being selected against, the roughly six-to-one ratio of Mallards to Black Ducks in the eastern states can be interpreted to mean that for every mixed pair formed there results six times as much damage to the Black Duck gene pool as to that of the Mallard. If the hybrids are not selected against, and they mate randomly with both Mallards and Black Ducks, then the possibility of eventual swamping of the Black Duck gene pool is six times greater than the alternative possibility.

In summary, these following points place the Black Duck at a selective disadvantage: (1) Its smaller gene pool will be affected much sooner by disadvantageous hybridization or possible swamping than will that of the Mallard, (2) the male Black Duck's sexually nondimorphic plumage and lack of special signal characters are, theoretically at least, of less sexual selection value than are those of the Mallard in a mating situation where sexual selection is intense, and (3) forest clearing, farm pond construction, and more intensive land use in the eastern states have resulted in continually decreasing Black Duck, and increasing Mallard, habitat.

## Evolutionary Implications and Taxonomic Conclusions

The extremely wide Holarctic range of the Common Mallard leaves little doubt that it is the oldest of the forms under discussion, and can probably be regarded as being closest to the ancestral form. I also believe that the sexually dimorphic condition of the Common Mallard is of long standing, for a strikingly similar plumage pattern is found in the otherwise well-differentiated and allopatric Australian and New Zealand Chestnut-breasted and Brown Teals (*Anas castanea-Anas aucklandica* complex), which must have been isolated from the Mallard for a much longer period than any of the populations under consideration here. Of these latter forms, I believe that the degree of genetic difference from the Common Mallard, from least to greatest, is indicated by the sequence *diazi* < *maculosa* ≅ *fulvigula* < *rubripes*.

Isolation of the Black Duck from the ancestral mallard stock probably originated through the establishment of an eastern population that was separated by the hardwood forests from the prairie populations of *Anas*. Such isolation would allow for the loss of sexual dimorphism through reduced pressures for species recognition (Sibley, 1957). Probably this coastal population gradually moved westward and northward into the swamps and waterways of the hardwood and evergreen forests, where selection for a darker, concealing, body plumage would likely obtain. By the time the population had extended far enough westward to establish a secondary contact with the prairie mallards, sufficient habitat adaptation had presumably been evolved to reduce greatly the actual contact between the two forms.

Much more recently, breeding populations of mallards were established on the central plateau and eastern coasts of Mexico. This may have occurred during a period of glaciation, when the prairie mallard population was forced southward and the ancestral Black Duck population was restricted to the southeastern states. Lakes in the central plateau of Mexico were apparently much more extensive during this period (Jaeger, 1925), and suitable breeding habitat may have likewise been much more extensive. Later, when the warmer and drier postglacial climate resulted in a drying up of many of these pluvial lakes and caused a northward movement of waterfowl populations, a small, residual population of mallards probably remained on the few areas of suitable habitat on the plateau. At the same time, the coastal population, separated from the plateau population by an altitudinal barrier of 7,000 feet, probably began to extend northward along the Gulf Coast. Both the coastal and plateau populations probably lost their sexual dimorphism rapidly, judging from the simple genetic control of this character, in response to a lack of other sympatric breeding species of *Anas*. The coastal population also evolved a darker plumage, presumably in response to its more humid environment. This was achieved by the same mechanical, if not genetic, mechanism as in the Black Duck, that is, by the reduction in width of the buff edging and bars of the contour feathers. The plateau population, however, remained essentially unchanged in this respect. Eventually part of the coastal population reached peninsular Florida (after crossing an area of apparently now relatively unfavorable habitat along the coasts of Mississippi, Alabama, and western Florida) and established a semi-isolated population in the southern part of that state.

This explanation thus hypothesizes the establishment of three major isolated populations from parental prairie mallard stock, each of which independently evolved sexually nondimorphic plumage and varying degrees of darker coloration. The same mutations may, however, have been utilized in some cases to achieve these ends. As indicated earlier, the Black Duck may have lost its sexual dimorphism by an inhibition of the genetic basis for this character, whereas in the Mottled Duck at least the genes governing it seem to have been eliminated.

I am in firm agreement with Delacour (1956) that *diazi* and *fulvigula* should be considered subspecies of *Anas platyrhynchos*, and likewise agree that *novimexicana* is inadmissible and should be synonymized with *diazi*. Results of the plumage study, however, force me to conclude that *maculosa* is a valid race, a determination in opposition to Delacour's opinion.

An accurate and completely satisfactory disposition of *rubripes* cannot, in my opinion, be made. No modern taxonomist has as yet formally proposed the conspecificity of *rubripes* and *platyrhynchos*, although the possibility has been suggested (Baillie, in Goodwin, 1956). Delacour (1956) states that only the rather wide area of sympatry in breeding ranges prevents this interpretation. Dr. Milton Trautman, who has studied the Black Duck carefully for many years, has concluded *(in litt.)* that "the Black and Mallard probably are not 'good' species as we normally define species in birds, but that they are 'potential' species which as yet have developed no genetic isolation but which display marked (subspecific at least) habitat differences and a marked mutation in coloration." I completely agree with this opinion, and feel that these habitat differences are of greater significance than is the relatively recent sympatry of the forms. The marked separation of the two when they are inhabiting the same water area and the relatively infrequent occurrence of mixed courting groups indicate that recognition capacities are well developed. Hybrid frequency also indicates that pairing is far from random in wild populations.

Arguing against the species-distinctness of the forms are the apparently complete hybrid fertility, the great morphological (including both plumage and egg-white proteins) similarities, the essentially identical sexual behavior, and the evidence for increasing hybridization associated with increasing sympatry. In addition, there is no indication of any tendency toward the development of any unique signal characters. Thus, depending upon one's viewpoint, evidence can be marshaled either to treat the two forms as subspecies or as species. There is little probability that speciation in the Black Duck will progress any further because of the extensive secondary contact, and indeed it is possible that the form will eventually become so genetically intermixed with the Mallard that specific recognition will be impossible from a practical as well as a theoretical standpoint. I, therefore, believe that the most satisfactory status for *rubripes* is to consider it a subspecies of *Anas platyrhynchos*, but one that exhibits a greater degree of differences in ecological preference and social segregation than normally occurs in subspecies. Neither a subspecific nor a specific relegation can be entirely satisfactory at present, and only time and continued investigations are likely to prove or disprove the conclusions reached here.

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## SUMMARY

A comparative morphological, behavioral, and electrophoretic study was undertaken on six populations of North American mallards that are currently considered by the A.O.U. *Check-list* to comprise four species and two additional subspecies. These include *Anas p. platyrhynchos, A. d. diazi, A. d. novimexicana, A. f. fulvigula, A. f. maculosa,* and *A. rubripes.* These forms are essentially allopatric in their breeding distributions, with the major exception of *A. p. platyrhynchos* and *A. rubripes,* which overlap throughout a several-hundred-mile zone in east-central United States.

Geographic ranges and population sizes are estimated, and evidence is presented to indicate that the present sympatry of *rubripes* and *platyrhynchos* is of recent origin and is rapidly increasing. Plumage differences in the populations were investigated by the "Hybrid index" method, and it was concluded that, except for the sexual dimorphism of *platyrhynchos,* only minor quantitative differences in feather patterns differ-

entiate the populations. Evidence from experimental hybridization was presented to show that the genetic basis for the sexual dimorphism of *platyrhynchos* is relatively simple, and should not be considered an important taxonomic criterion. Analysis of the sexual behavior of male *platyrhynchos* and *rubripes* failed to reveal any important differences other than slight differences in male response thresholds. Electrophoretic studies of the egg-white proteins of *platyrhynchos*, *rubripes*, and *fulvigula* likewise failed to show any noticeable differences in the proportions and electrophoretic characteristics of these proteins.

A discussion of ecological, geographic, and behavioral isolating mechanisms of the populations, and the incidence of hybridization where they overlap resulted in the conclusion that none of the forms could reasonably be considered specifically distinct from any or all of the others. It is recommended that *diazi*, *fulvigula*, and *maculosa* be considered geographic races of *Anas platyrhynchos*, and that *novimexicana* be considered a synonym of *diazi*. It is also concluded that *rubripes* cannot satisfactorily be considered a distinct species and that increasing hybridization indicates that it might eventually be necessary to consider it a subspecies of *Anas platyrhynchos*.

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# REVISED LIST OF THE BIRDS OF THE COMMANDER ISLANDS

HANS JOHANSEN

THE birds that occur in the Commander Islands are relatively well known, although their seasonal status is often misunderstood. More than half of the species recorded from these islands are only accidental visitors or were carried to the islands by storms. Some of these birds have been collected or observed during their normal breeding season, giving rise to the impression that they breed in the islands. Hartert was thus misled in many instances in writing his classic work *Die Vögel der Paläarktischen Fauna* (1903–1922), and his errors have been perpetuated in other lists, such as Peters' *Check-list of Birds of the World*, and the *Check-list of North American Birds* published by the American Ornithologists' Union. I have set forth below the correct status of the birds of the Commander Islands in so far as it is known to me. I have already discussed these birds (1934) after spending more than three years in these islands, but this paper, which was published in Tomsk in Siberia in a serial virtually unknown outside of the Soviet Union, is no longer available.

The Commander Islands were discovered accidentally by Vitus Bering when his ship was wrecked on these islands on its return to Kamchatka during the expedition to North America. Pallas was the first to mention the birds of the Commanders in his famous *Zoographia Rosso-Asiatica* (1811), and based his report on a manuscript of Steller, the scientific assistant to Bering. From Steller's notes Pallas described *Phalacrocorax perspicillatus*, the only bird that was endemic to these islands. This bird is now extinct, but seems to have been fairly abundant in 1830–1840 when Kuprianov, the governor of Sitka, collected five specimens that are now in the museums of Leningrad, Helsinki, Leiden, and London.

Toward the end of the last century much ornithological work was done on the islands. Between 1870 and 1880 Dybovski, Grinevitski, and Vosnesenski collected birds there, and Dybovski, together with Taczanovski, published a list of 107 species. The governor of the islands, Dr. N. Grebnitski, who stayed on the islands for 25 years (1880–1905), collected many specimens, sending them to the museum of St. Petersburg (Leningrad), and also to Dybovski and Stejneger. The latter visited the islands several times between 1882 and 1884 and made a collection of about 2,000 specimens, which is in the United States National Museum in Washington. Stejneger's paper, *Results of Ornithological Explorations in the Commander Islands and Kamtschatka* (1885) with excellent

plates, is the best and most important work on the birds of the Commander Islands but, of course, is now partly out of date.

Sokolnikov, the new governor of the islands (1905–1916), was also an eager bird collector. He sent his first 200 skins to the museum in St. Petersburg where, together with the older collections of Grebnitski and those of Grinevitski and Vosnesenski, they were described by Bianchi (1911). The other specimens collected by Sokolnikov (from 1909 to 1916)—about 860 skins—were bought by Rothschild for the Tring Museum, and studied by Hartert (1920). This collection is now in the American Museum of Natural History. Some smaller collections were made between 1910 and 1913, and one of them, consisting of 127 skins, was reported upon by Buturlin (1913); this paper is of special interest as all the specimens were taken on Copper Island.

My own paper (1934) was based on my observations and collections (212 skins) made during a stay of three and a half years on the islands as scientific assistant of the fur commission. During the preparation of the present paper, I also examined the Sokolnikov collection in the American Museum of Natural History.

The assumption that many birds visiting the Commanders remain to breed is based on a misconception of the prevailing ecological conditions. It is therefore necessary to give a short description of these islands (*Komandorskie Ostrova* in Russian). They are situated relatively far south, about 200 miles off the coast of eastern Kamchatka at about latitude 55° N. by longitude 167° E., but, nevertheless, are truly subarctic. They consist of four islands, of which only two, Bering and Copper, have any importance. The largest, Bering Island, is 95 kilometers long by an average of about 18 in width. The central and southern parts of the island are rocky and mountainous, reaching an elevation of 757 meters at Mount Steller. The northern end is more or less flat, consisting of some small, low plateaus and broad, low ridges, interspersed with lakes and swamps; these moist lowlands are called the "wet tundra." The more elevated parts are covered by dry upland tundra, sometimes stony.

Copper Island is separated from Bering by a strait of 48 kilometers and is 53 kilometers long by an average of only 3.5 wide. It is all mountainous with high, rocky cliffs dropping down to the sea, and cut by many steep valleys with small but rapid creeks. The other two islands (Ariy Kamen and Toporkov) are very small and lie off and near the coast of Bering. Their only interest consists in their large breeding colonies of a few species of sea birds.

The climate of the Commander Islands is extremely oceanic, the winter being relatively warm and the summer very cool (the average July tem-

perature being only 9° C). Spring begins at the end of May or the beginning of June. The summer is almost always foggy and the sun rarely seen, fierce storms prevail during the autumn and winter, and, as a result, the arborescent vegetation is poor, consisting of dwarf birches, several willows, and mountain ash *(Sorbus)*, which hardly reach a height of six feet, and this only in the most sheltered valleys. These valleys are thickly overgrown with high grass, but the grass cover becomes low and scanty in open country and on the hills.

In view of these conditions, the land fauna is very poor, and the only indigenous mammal is the polar fox. The other land mammals consist of three introduced species: the reindeer, the housemouse in the villages, and the red mouse *(Evotomys rutilus)*. The latter is restricted to Bering, where it was accidentally introduced in the middle of the last century. It has become abundant, and this has had an important bearing on the status of the Snowy Owl. This bird was rare in Stejneger's time but now breeds commonly on Bering but not on Copper where there is no red mouse.

The list of birds consists of 175 species, but many are only stragglers or accidental visitors. Regular migrants or visitors are less numerous, and only 55 species breed in the islands. More than half of the breeding birds are sea or water birds, the land and shore birds numbering only about 20 species. The avifauna is predominantly Palearctic, although a few species have been derived from the Nearctic region.

## SYSTEMATIC LIST

The nomenclature followed is chiefly that in use in the latest edition of the *A.O.U. Check-list* published by the American Ornithologists' Union (1957). Only Bering and Copper Islands are referred to, as a rule, or are combined under the term "both islands."

### BREEDING BIRDS

1. *Gavia stellata stellata*, Red-throated Loon
   Common breeder on both islands.
2. *Fulmarus glacialis rodgersii*, Fulmar
   Common breeder on both islands. The dark phase is much more frequent than the whitish one.
3. *Oceanodroma furcata furcata*, Fork-tailed Petrel
   Breeds in colonies on Copper, and possibly also in the southern part of Bering.
4. *Oceanodroma leucorhoa leucorhoa*, Leach's Petrel
   Breeds in small numbers with the preceding species on Copper.
5. *Phalacrocorax pelagicus pelagicus*, Pelagic Cormorant
   Resident and common breeder on both islands.
6. *Phalacrocorax urile*, Red-faced Cormorant
   Resident breeder in the northern part of Copper.

7. *Phalacrocorax perspicillatus*, Pallas' Cormorant
   Extinct. Last seen in 1852.
8. *Branta canadensis* subsp., Canada Goose
   Formerly rare breeder on Bering. The last specimen was collected in 1914 by Sokolnikov. I did not see it during my stay (1928-1931).
9. *Anas platyrhynchos platyrhynchos*, Mallard
   Common breeder in the northern part of Bering. Possibly single pairs breed also on Copper.
10. *Anas acuta*, Pintail
    The most common surface duck on both islands.
11. *Anas crecca crecca*, Common Teal
    Common breeder on both islands.
12. *Spatula clypeata*, Shoveler
    This species may breed on Bering according to Stejneger, but breeding records are lacking.
13. *Aythya marila*, Greater Scaup
    Common breeder on both islands; seems to be intermediate between the nominate race and *nearctica*.
14. *Aythya fuligula*, Tufted Duck
    This species is a rare summer resident and, undoubtedly, breeds, although this has not been confirmed.
15. *Clangula hyemalis*, Oldsquaw
    Fairly common breeder and abundant on the sea during the winter.
16. *Histrionicus histrionicus pacificus*, Harlequin Duck
    Resident on both islands and abundant on the sea during the winter.
17. *Somateria mollissima v-nigrum*, Common Eider
    Resident, but breeding records exist only for Copper Island.
18. *Mergus merganser merganser*, Common Merganser
    A rare breeder according to Stejneger, but this bird has been seen by me only in the spring and single individuals in winter.
19. *Mergus serrator serrator*, Red-breasted Merganser
    Breeds on both islands. Not common.
20. *Haliaeetus leucocephalus alascanus*, Bald Eagle
    Formerly resident breeder according to Stejneger (1885), but during my stay only single individuals were seen in winter by natives.
21. *Falco rusticolus grebnitzkii*, Gyrfalcon
    A rare breeder on Bering according to Stejneger (1885), but I have seen it only during the winter, and the 12 specimens collected by Sokolnikov were collected at that season.
22. *Falco peregrinus*, Peregrine Falcon
    Resident on both islands. The breeding form is very large and very dark, and is *pealei*. During migration a pale form occurs also, probably *calidus*.
23. *Lagopus mutus ridgwayi*, Rock Ptarmigan
    Common and abundant breeder on both islands.
24. *Charadrius mongolus stegmanni*, Mongolian Plover
    Common breeder on both islands.
25. *Gallinago gallinago gallinago*, Common Snipe
    Common breeder on Bering.

26. *Heteroscelus brevipes*, Siberian Tattler
Possibly rare breeder. Seen in summer, and young birds have also been collected late in August. Regular migrant.
27. *Tringa glareola*, Wood Sandpiper
Common breeder on Bering, and rare breeder on Copper.
28. *Erolia ptilocnemis quarta*, Rock Sandpiper
Resident common breeder on both islands.
29. *Erolia subminuta*, Long-toed Stint
Breeds on Bering where I have found its nest and eggs, and probably breeds also on Copper. It is frequent on migration on both islands.
30. *Lobipes lobatus*, Northern Phalarope
Common breeder on Bering, and probably breeding rarely on Copper.
31. *Stercorarius pomarinus*, Pomarine Jaeger
Breeds on both islands, the light and dark phase being equally represented.
32. *Stercorarius parasiticus*, Parasitic Jaeger
Breeds on both islands, also in both phases.
33. *Stercorarius longicaudus pallescens*, Long-tailed Jaeger
Has been captured several times during the breeding season, and probably is a rare breeder.
34. *Larus glaucescens*, Glaucous-winged Gull
The most common breeding gull on the islands. Partly resident, but most of the birds that remain during the winter are young.
35. *Rissa tridactyla pollicaris*, Kittiwake
Common, partly resident, and breeds on both islands.
36. *Rissa brevirostris*, Red-legged Kittiwake
Less common than the preceding and breeds only on Copper and the southern part of Bering. Not seen in winter.
37. *Sterna paradisaea*, Arctic Tern
Single pairs may breed on Bering as Stejneger (1885) states, but this has not been confirmed by me.
38. *Uria aalge inornata*, Common Murre
Breeds on both islands in limited numbers.
39. *Uria lomvia arra*, Thick-billed Murre
The most common sea bird on the islands. Winters probably in the open sea.
40. *Cepphus columba kaiurka*, Pigeon Guillemot
Very common breeder on both islands. Not seen in winter.
41. *Synthliboramphus antiquum*, Ancient Murrelet
Fairly frequent breeder on Copper.
42. *Cyclorrhynchus psittacula*, Parakeet Auklet
Fairly common breeder on both islands.
43. *Aethia cristatella*, Crested Auklet
Stejneger (1885) states this species breeds on Bering and Copper, but it was not found by me during the breeding season. Sokolnikov's collection consists only of birds taken during the winter.
44. *Aethia pygmaea*, Whiskered Auklet
Resident breeder on both islands but more frequent on Copper.
45. *Fratercula corniculata*, Horned Puffin
Common breeder on both islands. In winter in the open sea.

46. *Lunda cirrhata*, Tufted Puffin
One of the most common breeders, especially on the little "Toporkov Island" near Bering where I counted about 100,000 pairs. In winter in the open sea.
47. *Nyctea scandiaca*, Snowy Owl
Resident and breeding on Bering. Has increased greatly in numbers, the increase being correlated with the enormous increase in the introduced red mouse during the last 100 years.
48. *Asio flammeus flammeus*, Short-eared Owl
Stejneger (1885) states that it is a rare resident on both islands, but no one has collected this species since. A native told me he saw one many years ago.
49. *Corvus corax kamtschaticus*, Common Raven
Resident and breeds on both islands.
50. *Troglodytes troglodytes pallescens*, Winter Wren
Resident and fairly common breeder on both islands.
51. *Motacilla flava simillima*, Yellow Wagtail
Breeds rarely on Bering, as I observed the species in July and in the beginning of August. Frequent and regular during spring migration on both islands.
52. *Anthus gustavi commandorensis*, Pechora Pipit
Common breeder in the grassy parts of the islands.
53. *Leucosticte tephrocotis maxima*, Gray-crowned Rosy Finch
Resident on both islands.
54. *Acanthis flammea flammea*, Common Redpoll
Resident. Breeds in the valleys of the southern part of Bering.
55. *Calcarius lapponicus coloratus*, Lapland Longspur
The most common summer resident among the Passeriformes.
56. *Plectrophenax nivalis townsendi*, Snow Bunting
Resident and breeds on both islands. Some birds that occur in the Commanders are probably migrants, as I have seen small flocks at a time when the local birds were already paired.

### REGULAR MIGRANT AND WINTER VISITORS

1. *Olor cygnus*, Whooper Swan
Regular migrant, more frequent in the autumn. Rare in the winter.
2. *Philacte canagica*, Emperor Goose
October to April in small flocks on the coast.
3. *Anser albifrons frontalis*, White-fronted Goose
Regular spring migrant, more rare in the autumn.
4. *Anser fabalis serrirostris*, Tundra Bean Goose
Regular in the spring, rare in the autumn.
5. *Mareca penelope*, European Widgeon
Regular spring migrant. Extremely rare in the autumn.
6. *Polysticta stelleri*, Steller's Eider
Large flocks in the winter on the sea.
7. *Somateria spectabilis*, King Eider
In the winter on the sea.
8. *Melanitta deglandi stejnegeri*, White-winged Scoter
Fairly common in the spring and in the autumn near the coast. Rare in the winter.

9. *Oidemia nigra americana*, Common Scoter
   Stejneger states (1885) that it is found in small numbers on the open sea during the winter, but I have neither collected this bird nor am I certain that I have seen it.
10. *Pluvialis dominica fulva*, Golden Plover
   Regular and common spring and autumn migrant.
11. *Squatarola squatarola*, Black-bellied Plover
   Regular migrant, but more frequent in the autumn.
12. *Arenaria interpres interpres*, Turnstone
   Very common regular spring and autumn migrant. Seen also in the summer on the coast, but there are no breeding records.
13. *Numenius phaeopus variegatus*, Whimbrel
   Regular spring and autumn migrant.
14. *Actitis hypoleucos*, Common Sandpiper
   Regular migrant on Bering. Found on Copper only in the spring.
15. *Erolia temminckii*, Temminck's Stint
   Regular but rare migrant.
16. *Erolia ruficollis*, Rufous-necked Sandpiper
   Regular spring and autumn migrant.
17. *Erolia alpina sakhalina*, Dunlin
   Regular but not common in the spring and in the autumn.
18. *Limosa limosa melanuroides*, Black-tailed Godwit
   Rare spring migrant.
19. *Limosa lapponica baueri*, Bar-tailed Godwit
   Common during migration. Some individuals remain in the summer but probably do not breed.
20. *Larus hyperboreus* subsp.?, Glaucous Gull
   Common migrant in the spring and in the autumn on both islands. Rare in winter.
21. *Larus schistisagus*, Slaty-backed Gull
   Common spring and autumn migrant. Rare in January and February but frequent from March to June.
22. *Larus argentatus vegae*, Herring Gull
   Regular migrant but less frequent than the two preceding species.
23. *Alauda arvensis pekinensis*, Skylark
   Regular spring visitor on Bering, but not breeding as stated by Bianchi (1909).
24. *Motacilla alba*, White Wagtail
   Regular visitor in the spring, rare in the autumn. Two subspecies occur: *M. a. ocularis* and *M. a. lugens*.
25. *Fringilla montifringilla*, Brambling
   Regular migrant in small flocks on both islands, but less frequent in the autumn.
26. *Acanthis hornemanni exilipes*, Hoary Redpoll
   Regular winter visitor. The latest record is from 13 May.

### ACCIDENTALS AND STRAGGLERS

1. *Gavia immer*, Common Loon
   One specimen was collected in the 1880's.

2. *Gavia adamsii*, Yellow-billed Loon
   Occasional in the winter and in the spring on the open sea.
3. *Gavia arctica* subsp.?, Arctic Loon
   Irregular visitor in the spring and in the autumn. The specimens in Sokolnikov's collection seem to be intermediate between *viridigularis* and *pacifica*.
4. *Podiceps grisegena holboellii*, Red-necked Grebe
   Occasional in the spring and in the autumn on both islands.
5. *Podiceps auritus auritus*, Horned Grebe
   Rare accidental visitor.
6. *Diomedea albatrus*, Short-tailed Albatross
   Rare on the open sea from March to October, according to Stejneger (1885).
7. *Diomedea nigripes*, Black-footed Albatross
   Observed 12 June 1906 between Attu (Aleutian Islands) and Copper Island by A. H. Clark (1910).
8. *Puffinus tenuirostris*, Slender-billed Shearwater
   In summer time single migratory individuals are observed in the open sea.
9. *Cygnus columbianus*, Whistling Swan
   One specimen collected in November 1882, according to Stejneger (1885).
10. *Branta bernicla nigricans*, Black Brant
    Rare straggler in the autumn.
11. *Cygnopsis cygnoides*, Swan Goose
    Doubtful. Dybovski is said to have had a record from Bering (Stejneger, 1887).
12. *Chen hyperborea hyperborea*, Snow Goose
    A white female collected 30 May 1911 on Bering (Hartert, 1920).
13. *Anas strepera*, Gadwall
    Rare accidental visitor.
14. *Anas falcata*, Falcated Teal
    Rare straggler in the spring.
15. *Anas formosa*, Baikal Teal
    Rare straggler.
16. *Anas querquedula*, Garganey
    Rare straggler.
17. *Mareca americana*, American Widgeon
    One specimen collected May 1883 (Stejneger, 1885).
18. *Aythya ferina*, Common Pochard
    Rare accidental visitor.
19. *Bucephala clangula clangula*, Common Goldeneye
    Regular but rare straggler in the spring and in the autumn. Occasional in the winter.
20. *Bucephala albeola*, Bufflehead
    Rare winter straggler.
21. *Melanitta deglandi*, White-winged Scoter
    Accidental visitor. The three specimens known from Bering and Copper may belong to the Alaskan race *dixoni* (Hartert, 1920).
22. *Melanitta perspicillata*, Surf Scoter
    Accidental visitor in the spring and autumn.
23. *Mergus squamatus*, Chinese Merganser
    One specimen collected 9 June 1911 on Copper (Hartert, 1920).

24. *Mergus albellus*, Little Merganser
Rare straggler in the spring and autumn.
25. *Accipiter gentilis albidus*, Goshawk
Accidental visitor.
26. *Accipiter nisus nisosimilis*, Sparrow Hawk
Accidental visitor.
27. *Buteo lagopus menzbieri*, Rough-legged Hawk
Winter and spring straggler.
28. *Haliaeetus albicilla*, Gray Sea Eagle
Accidental visitor.
29. *Haliaeetus pelagicus*, Steller's Sea Eagle
Regular but rare straggler.
30. *Pandion haliaetus haliactus*, Osprey
Regular visitor from Kamchatka in the spring and summer.
31. *Falco columbarius insignis*, Pigeon Hawk
One specimen collected 10 June 1915 on Bering (Hartert, 1920).
32. *Grus canadensis*, Sandhill Crane
Accidental on Bering.
33. *Haematopus ostralegus osculans*, Oystercatcher
One specimen recorded by Stejneger 19 June 1883 on Bering.
34. *Charadrius alexandrinus alexandrinus*, Snowy Plover
One specimen collected by Sokolnikov 21 November 1911 on Bering.
35. *Charadrius morinellus*, Dotterel
Shot on Bering September 1928.
36. *Gallinago solitaria japonica*, Solitary Snipe
Rare straggler from Kamchatka.
37. *Numenius madagascariensis*, Australian Curlew
Straggler from Kamchatka. Only three records.
38. *Heteroscelus incanus*, Wandering Tattler
Fairly common spring straggler on Bering.
39. *Tringa erythropus*, Spotted Redshank
Infrequent spring straggler on Bering.
40. *Tringa nebularia*, Greenshank
Regular and common straggler in the spring and in the autumn.
41. *Tringa guttifer*, Nordmann's Greenshank
One specimen obtained by Stejneger 22 May 1883.
42. *Xenus cinereus*, Terek Sandpiper
One specimen obtained by Stejneger 9 September 1884.
43. *Calidris tenuirostris*, Great Knot
One specimen collected May 1881 by Grebnitski (Bianchi, 1909).
44. *Erolia melanotos*, Pectoral Sandpiper
Rare straggler in the autumn.
45. *Erolia acuminata*, Sharp-tailed Sandpiper
Rare straggler in the autumn.
46. *Erolia ferruginea*, Curlew Sandpiper
Rare straggler in the spring and autumn (two records only).
47. *Philomachus pugnax*, Ruff
Very rare straggler in the spring and summer.
48. *Crocethia alba*, Sanderling
Rare straggler.

49. *Eurynorhynchus pygmeus*, Spoon-bill Sandpiper
One specimen collected 5 September 1911 on Bering (Hartert, 1920).
50. *Phalaropus fulicarius*, Red Phalarope
Irregular migrant on both islands.
51. *Larus kamtschatschensis*, Kamchatka Gull
Accidental on both islands. This species is closely related to *Larus delawarensis*. (A paper on this matter is in press.)
52. *Larus canus brachyrhynchus*, Mew Gull
Accidental in the autumn and winter (three records).
53. *Larus ridibundus sibiricus*, Black-headed Gull
Rare straggler to both islands, mostly in the spring.
54. *Rhodostethia rosea*, Ross' Gull
Rare straggler in the winter (four records).
55. *Xema sabini* subsp.?, Sabine's Gull
One specimen collected 16 May 1913 on Bering (Hartert, 1920).
56. *Sterna hirundo longipes*, Common Tern
Fairly common straggler to both islands.
57. *Sterna aleutica*, Aleutian Tern
One specimen collected 7 September 1911 on Copper (Hartert, 1920).
58. *Cepphus carbo*, Black Guillemot
A pair was seen by Stejneger (1885) on Bering in April 1883. No other records.
59. *Brachyramphus marmoratum*, Marbled Murrelet
Rare accidental visitor from Kamchatka.
60. *Aethia pusilla*, Least Auklet
Straggler in the winter, rare in the spring.
61. *Cerorhinca monocerata*, Rhinoceros Auklet
Two specimens collected by Grebnitski in 1880 and 1881 (Stejneger, 1885).
62. *Cuculus canorus telephonus*, Cuckoo
Rare straggler in May and June on both islands.
63. *Cuculus saturatus horsfieldi*, Oriental Cuckoo
Rare straggler in June, July, and in the autumn to the islands.
64. *Aegolius funereus magnus*, Boreal Owl
One specimen collected 31 January 1911 on Bering (Hartert, 1920).
65. *Dendrocopos major camtschaticus*, Great Spotted Woodpecker
Accidental visitor from Kamchatka.
66. *Riparia riparia ijimae*, Bank Swallow
Irregular straggler in the spring and summer.
67. *Hirundo rustica*, Barn Swallow
Rare straggler. Stejneger (1885) watched the brown-bellied race *tytleri;* I collected four specimens of the white-bellied race *gutturalis* 27 August 1931.
68. *Corvus corone orientalis*, Carrion Crow
A single individual observed in the spring of 1883 on Bering (Stejneger, 1885).
69. *Parus atricapillus kamtschatkensis*, Black-capped Chickadee
Accidental visitor on Bering.
70. *Turdus naumanni eunomus*, Dusky Thrush
Rare spring straggler on both islands.
71. *Turdus obscurus*, Eye-browed Thrush
Sporadic straggler in the spring and early summer.

72. *Oenanthe oenanthe oenanthe*, Wheatear
Accidental visitor in the autumn on both islands.
73. *Luscinia calliope*, Siberian Rubythroat
Occasional straggler to the islands.
74. *Tarsiger cyanurus*, Red-flanked Bluetail
Regular straggler, more frequent on Bering.
75. *Phylloscopus borealis xanthodryas*, Arctic Warbler
Regular straggler in the spring; rare in the autumn.
76. *Locustella ochotensis*, Middendorff's Grasshopper Warbler
Regular straggler in the spring. Was collected in July, but no breeding records.
77. *Motacilla cinerea robusta*, Gray Wagtail
Rare spring visitor; accidental in the autumn.
78. *Anthus spinoletta japonicus*, Water Pipit
Rare straggler to both islands.
79. *Anthus cervinus*, Red-throated Pipit
Rare straggler to Bering.
80. *Anthus hodgsoni yunnanensis*, Indian Tree Pipit
Accidental on both islands.
81. *Bombycilla garrulus centralasiae*, Bohemian Waxwing
Rare straggler to both islands.
82. *Muscicapa griseisticta*, Gray-spotted Flycatcher
Rare accidental. Two records only: in the spring of 1883 and 1912 (Hartert, 1920).
83. *Muscicapa sibirica*, Sooty Flycatcher
This species invaded Bering in good numbers in the spring of 1883, according to Stejneger (1885), but has not been seen since.
84. *Ficedula parva albicilla*, Red-breasted Flycatcher
Irregular straggler in the spring.
85. *Coccothraustes coccothraustes japonicus*, Hawfinch
One specimen collected 24 May 1912 on Bering (Hartert, 1920).
86. *Pyrrhula pyrrhula cassini*, Bullfinch
Rare accidental visitor; two records in the summer of 1913 and in 1919 (Hartert, 1920).
87. *Carpodacus erythrinus grebnitzkii*, Common Rose Finch
Rare straggler to both islands.
88. *Pinicola enucleator kamtschatkensis*, Pine Grosbeak
One specimen collected by Sokolnikov, but its label was lost (Hartert, 1920).
89. *Loxia curvirostra japonica*, Red Crossbill
One specimen collected by Grebnitski in December 1880 on Bering.
90. *Emberiza rustica latifascia*, Rusting Bunting
Irregular straggler in the spring on both islands.
91. *Emberiza variabilis*, Gray Bunting
One specimen collected by Stejneger 11 June 1883 on Bering (Stejneger, 1885).
92. *Emberiza aureola kamtschatica*, Yellow-breasted Bunting
Irregular visitor in the spring and early summer.
93. *Emberiza schoeniclus pyrrhulina*, Reed Bunting
The only specimen known was collected 20 May 1930 by me (Johansen, 1934).

## NOTE

*Larus genei*, Slender-billed Gull

The record of this bird for the Commanders is based on a single specimen collected by Sokolnikov 7 October 1912, and reported by Hartert (1920). This specimen, however, was misidentified and is a *Larus ridibundus sibiricus*.

## CHECK-LIST OF NORTH AMERICAN BIRDS

The latest edition of the *Check-list* published by the American Ornithologists' Union (1957) contains a number of errors concerning the status of the birds of the Commander Islands. The more important ones are listed below with the page number of the *Check-list;* the correct status of the species concerned is indicated in the systematic list above.

A. Birds listed erroneously as breeding.
*Podiceps grisegena holboellii* (p. 4)
*Branta canadensis* (p. 60)
*Anas strepera* (p. 73)
*Anas falcata* (p. 75)
*Marecа penelope* (p. 78)
*Spatula clypeata* (p. 80)
*Bucephala clangula* (p. 85)
*Melanitta perspicillata* (p. 93)
*Haematopus ostralegus* (p. 164)
*Charadrius alexandrinus* (p. 168)
*Pluvialis dominica fulva* (p. 173)
*Erolia ferruginea* (p. 198)
*Larus schistisagus* (p. 219)
*Apus pacificus* (p. 299)
*Locustella ochotensis ochotensis* (p. 450)
*Motacilla alba lugens* (p. 456)
*Pyrrhula pyrrhula cassini* (p. 558)
*Emberiza rustica latifascia* (p. 641)

B. Species for which the Commanders should be added to the breeding range.
*Anas crecca* (p. 75)
*Aythya marila* (p. 83)
*Falco peregrinus pealei* (p. 119)
*Stercorarius pomarinus* (p. 212)
*Plectrophenax nivalis townsendi* (p. 641)

## ACKNOWLEDGMENTS

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# LIST OF AND NOTES ON THE BIRDS OF THE ILES DES SAINTES, FRENCH WEST INDIES

CHARLES VAURIE

LES Saintes, a small archipelago that lies south of Guadeloupe, has seldom been visited by ornithologists. No list of its birds seems to have been published, although, to be sure, 25 species have been mentioned from these islands by Noble (1916), Bond (1936, 1956), Danforth (1939), or Pinchon and Bon Saint-Come (1951). Three of these were recorded on doubtful evidence and, pending confirmation, should be deleted from the list. Nineteen of the remaining 22 and an additional five were observed by me on 2–5 July 1960, when Mrs. Vaurie and I visited the French West Indies for the American Museum of Natural History. The species mentioned by Noble and Danforth were incorporated in their reports on the birds of Guadeloupe, those cited by Bond or Pinchon and Bon Saint-Come in general works on the birds of the West Indies. The birds reported so far are listed below with a few notes.

I am grateful to James Bond for his very helpful advice, Eugene Eisenmann for reading the manuscript, and to the Gendarmerie of Basse Terre and Terre-de-haut for arranging our visit as there is no hotel in Les Saintes.

Les Saintes are of volcanic origin and are separated from the Basse Terre in Guadeloupe by a stormy channel seven miles wide. They consist of two relatively large islands called Terre-de-bas and Terre-de-haut, the only islands inhabited, and of six small islands or islets, some of which appear to be the sites of sea-bird colonies. One of these, called La Redonde, lies only 300 meters off Terre-de-haut but, unfortunately, is quite inaccessible as it rises perpendicularly out of the sea to a height of 46 meters and is pounded by huge waves that rise to nearly half its height. The top of La Redonde, which is about 170 meters wide, is alive all day with many sea birds. The other islets, which are probably occupied by birds also, are slightly lower than La Redonde but similar to it in structure.

Terre-de-haut, the only island we visited, is five kilometers long and varies from three quarters of a kilometer to two kilometers in width. The central part of the island is relatively flat, and its coastline is formed by two magnificent beaches about one kilometer long. The beach on the lee of the island is quiet, lined by the street of the village and coconut trees; the one to the windward is very broad, backed by dunes, and swept by great rollers. The island of Dominica, 16 miles away, is clearly visible from it. Two large, shallow, brackish ponds are found on this part of

the island, and one of these is surrounded by extensive flats that probably receive shore birds and perhaps ducks during the migration; but, so far, the only migrant noted for Les Saintes is the Oven-bird *(Seiurus aurocapillus)*. There are also several small, artificial ponds for watering cattle.

The rest of Terre-de-haut is rugged and formed by a series of transverse hills separated by narrow, deep valleys, and the coastline, except at the western end of the island, is very deeply indented by numerous bays and coves. This western end is formed by a double-headed hill, called Le Chameau, which rises to 309 meters (over 1,000 feet) and drops into the valley by a series of cliffs or steep slopes. These cliffs are the home of a colony of the Antillean Martin *(Progne dominicensis)* and of one pair of American Kestrels *(Falco sparverius)*. Le Chameau and the hill facing it across the valley are heavily wooded, many of the trees being large but giving way on the lower slopes to dense scrub consisting chiefly of mesquite. The floor of the valley is given over to pasture, one or two small gardens, and groves of mangos, citrus, or other leafy trees.

The western end of Terre-de-haut is the least disturbed and supports a good bird life. Some species, such as the hawk, pigeon, two of the doves, flycatcher, bullfinch, and Plumbeous Warbler, were seen only there. On the rest of the island the vegetation becomes more meager and the birds fewer. The many large iguanas *(Iguana delicatissma)*, which are found in its valley, add much to its charm and interest. They are not molested and sun themselves or stroll about unconcernedly. A snake, endemic to Les Saintes, is found there also but was not seen by us.

Terre-de-haut is very beautiful and interesting. It has preserved its fauna, since the mongoose, which has caused so much destruction in the rest of the West Indies, has never been introduced, and as its inhabitants have shown little interest in exploiting the island. The people are all descendants of Breton seamen and fisherfolk to whom the sea is home and living, although some older men make a desultory effort at cultivation and keep a few cows, sheep, and goats.

Terre-de-bas is much more regular in shape and uniform in its topography than is Terre-de-haut. It is squarish, measuring about three kilometers on a side, and rises to 293 meters. It is said to be more wooded than Terre-de-haut, a fact attested to by the map of vegetation.

Our visit coincided with a period of great activity on the part of the birds and insects, as the rains had started only about two weeks before, after five months of drought. Some birds were very vocal, and I observed chasing, suggesting territorial activity, although, no doubt, some had

started to nest earlier as Bond writes to me that "The height of the breeding season in the Lesser Antilles is in May, and many birds nest there in April."

In the list below, I have omitted three birds that were included by Danforth (1939) because they had been mentioned from Les Saintes by Noble (1916). These are: *Sula leucogaster* (Brown Booby), *S. sula* (Red-footed Booby), and *Thalasseus maximus* (Royal Tern). But Noble did not collect or see these birds, stating that they had been reported to him by fishermen. Danforth questioned the validity of two of these records, and it seems significant that Noble omitted all three birds from his list, mentioning them merely (with reservation) in the introduction to his paper.

Danforth visited Terre-de-haut on the afternoon of 5 July 1937, spending most of the morning on Terre-de-bas, or on the same day and month we visited Terre-de-haut. I have, therefore, quoted his observations when they differ from mine to some extent, and have also mentioned his records for Terre-de-bas, as all the records from that island in the literature, with the exception of *Crotophaga ani*, are to be found in his paper.

## Annotated List of the Birds of Les Saintes

*Puffinus lherminieri*, Audubon's Shearwater. Several seen between Terre-de-haut and Guadeloupe and also flying to and from La Redonde. Not recorded previously.

*Phaëthon aethereus*, Red-billed Tropic-bird. Reported by Danforth (1939) and Bond *(in litt.)*.

*? Phaëthon lepturus*, White-tailed Tropic-bird. Six birds were seen flying off La Redonde, but too far away to be identified as to species with certainty. The light was good, however, and I noted that they appeared to be all white on the back. After comparing skins, and before reading Danforth and hearing from Bond, I felt confident that they were *P. lepturus*. But Bond writes to me that the only species he observed was *P. aethereus*. The latter is also the only tropic bird reported by Danforth.

*Pelecanus occidentalis*, Brown Pelican. Single birds and bands of three, perhaps vagrants. Not recorded previously.

*Fregata magnificens*, Magnificent Frigate-bird. Common, but Danforth saw only one each at Terre-de-haut and Terre-de-bas. They are tamed also by the fishermen, and birds are found in the village.

*Butorides virescens*, Green Heron. Common and Noble (1916) reports six adult and half-grown birds taken during the first week in September, but only single birds were seen by Danforth on Terre-de-haut and Terre-de-bas.

*Falco sparverius*, American Kestrel. Two pairs in the valley at the western end of the island. This valley is divided in the middle by a small ridge, which constitutes apparently the limit of the territories as the birds were not seen to cross it. One pair had young and was seen carrying food to the nest, the prey consisting on all occasions of lizards. The nest was in leafy trees at the base of the cliff, or perhaps on the cliff that was difficult of approach. The martins mentioned above and the kestrel paid no apparent attention to one another, but the latter was put

to flight once by an Emerald-throated Hummingbird. Danforth collected this species also on Terre-de-bas.

*Sterna dougallii*, Roseate Tern. Common. Danforth did not find it on Terre-de-haut, but states he "observed many, apparently nesting on Terre-de-Bas and Grand Ilet." The latter is the largest of the smaller islands.

*Sterna fuscata*, Sooty Tern. Common and the most abundant of the terns. Bands of about 150 individuals were seen pursuing schools of small fish in company with a few Brown Noddies. It was very abundant also off La Redonde, but Danforth saw only three at Terre-de-haut and apparently none at Terre-de-bas. The Sooty is tamed by the natives also, and pets were seen on the doorsteps of houses.

*Anoüs stolidus*, Brown Noddy. Common. Danforth states he "found it nesting commonly on Grand Ilet and on the cliffs of Terre-de-bas, and observed a few (apparently not nesting) around Terre-de-Haut."

*Columba squamosa*, Scaly-naped Pigeon. Two flying together. Danforth saw "a few" on Terre-de-haut and says it was common on Terre-de-bas.

*Zenaida aurita*, Zenaida Dove. Common. Not recorded for Terre-de-bas.

*Columbigallina passerina*, Ground Dove. The amost abundant Columbidae and seen throughout the island. Danforth says it is "fairly common" on Terre-de-bas. The birds of this family seem to be the only ones that are hunted, people coming over from Guadeloupe for this purpose.

*Geotrygon mystacea*, Moustached Quail Dove. This bird, which is recorded by Bond, was not seen, but its distinctive booming note was heard from the woods on Le Chameau. Danforth saw it only on Terre-de-bas on the higher part of the mountain.

*Coccyzus minor*, Mangrove Cuckoo. In mangrove or dense scrub near the shore. Not recorded previously.

*Crotophaga ani*, Smooth-billed Ani. Associated with cows in bands of six or eight and remarkably unsuspicious for an ani. On other trips to the West Indies I noted that this bird, although easily watched, never allowed a very close approach, but on Terre-de-haut I could walk to within five or six feet of the birds in full view. They were feeding on a ground moth, about half an inch long, the only insect we could find. Some of the moths, which were abundant, were flushed by the cows, others by the bird itself.

Danforth "found it [to be] perhaps the commonest bird on Terre-de-Haut, frequenting pastures and brushy land, but observed none on Terre-de-Bas" from where it has been reported, however, by Pinchon and Bon Saint-Come (1951). Danforth collected two individuals and states "One stomach contained 15 weevils, *Lachnopus curvipes*, and the other 6 *Lachnopus curvipes* and a grasshopper." This is of interest, as Mrs. Vaurie (a coleopterist) and I found this weevil emerging in great numbers, mating on flowering mesquite, but the anis never approached the mesquite during our stay.

Rand (1953), who has studied the feeding rates of the Groove-billed Ani *(C. sulcirostris)* in Central America, found that when the birds were feeding with cows at the beginning of the rainy season they captured or tried to capture an insect on an average of 1.8 per minute. It did not occur to me to time the anis of Terre-de-haut, but they were certainly feeding at a much faster rate. It seems to me in retrospect that they would pause only for a few seconds between captures, and, no doubt, the feeding rate varies with the abundance of prey. I do not recall that they missed, probably because the insect was relatively slow and large.

The islanders told us that they call the bird "Merle Martinique." According to Pinchon and Bon Saint-Come, it is called "Merle de Porto-Rique" on Guadeloupe, and "Gros Merle de Sainte-Lucie" on Martinique, each island thus attributing it to another. On Guadeloupe and Martinique the name "Merle," without a qualifier, is given to the Lesser Antillean Grackle *(Quiscalus lugubris)*. It is curious to note that this grackle, although very adaptable and very widely distributed in the Lesser Antilles, is not found on Les Saintes, only seven miles away from Guadeloupe.

*Eulampis jugularis*, Garnet-throated Hummingbird. Recorded by Bond (1936, 1956), who writes to me that "I was told that the strikingly colored *Eulampis* has been seen [on Terre-de-bas] occasionally," but that the only two hummingbirds he saw in Les Saintes were *Sericotes holosericeus* and *Orthorhynchus cristatus*. He saw these on Terre-de-bas. *Eulampis jugularis* was not seen by me or Danforth.

*Sericotes holosericeus*, Emerald-throated Hummingbird. Common everywhere in open areas. Not recorded previously, although Bond (1956) implied that it occurs in Les Saintes and (see above) has seen it on Terre-de-bas.

*Orthorhynchus cristatus*, Antillean Crested Hummingbird. Equally common as the preceding species and in the same habitat. Common also on Terre-de-bas, according to Danforth.

*Elaenia martinica*, Lesser Antillean Elaenia. Two individuals that were very vocal were seen in the orchards or groves. Danforth saw it on Terre-de-haut and found it to be common on Terre-de-bas. The specimen he collected had been eating fruit.

*Progne dominicensis*, Antillean Martin. Common and apparently nesting in the cliffs mentioned. Danforth "found it breeding on the cliffs on both Terre-de-Bas and Terre-de-Haut."

*Vireo altiloquus*, Black-whiskered Vireo. Common. Danforth states it is common also on Terre-de-bas.

*Dendroica petechia*, Golden Warbler. Common throughout but more so near the shore in bushes and especially manchineel trees. Danforth found it to be common on both Terre-de-haut and Terre-de-bas.

*Dendroica plumbea*, Plumbeous Warbler. Two individuals singing in dense scrub at the foot of the hills at the western end of the island. They were located with difficulty as they were furtive and never came out in the open, but when finally tracked down after many scratches they prove to be not particularly nervous. They wag their tail constantly up and down like a Palm Warbler when perched and sing from a low, sheltered branch. The song is loud and musical, not typical of a warbler, and the call or alarm note a sharp "chick." The next day the two birds were heard and found at the same sites, a behavior that suggests they had established territories. Some old, cup-shaped nests that were found while searching for the birds may have belonged to this species. This warbler was known hitherto only from Dominica, Marie Galante, and Guadeloupe. It will probably be found also on Terre-de-bas.

*Seiurus aurocapillus*, Oven-bird. A winter visitor according to Bond.

*Coereba flaveola*, Bananaquit. Common. Not seen by Danforth, who was surprised not to find it on Terre-de-haut, as he states it was common on Terre-de-bas.

*Tiaris bicolor*, Black-faced Grassquit. Very common, the most abundant land bird. It may have been less abundant when Danforth visited the island as he says he "observed" it on Terre-de-haut, whereas he found it to be "common" on Terre-de-bas.

*Loxigilla noctis*, Lesser Antillean Bullfinch. Danforth states it is "Common on Terre-de-Bas, but not found on Terre-de-Haut." It seems to be rare in this last island, as I saw only one male accompanied by a female in habitat that seems eminently suitable for this species.

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# WINTER FEEDING PATTERNS IN THE HOUSE SPARROW*

JAMES R. BEER

BETWEEN 20 November 1949 and 31 March 1950, the feeding patterns of the House Sparrows *(Passer domesticus)* that frequented a feeding station in suburban St. Paul, Minnesota, were observed. These observations were made in order to obtain an understanding of how weather conditions affect feeding and the survival of these birds. The feeding station was located on the north side of a building, where it had some protection from the wind and was not disturbed by people or dogs. Bread and other foods that could not be carried away were kept on the station constantly. No other species of bird was observed using the station. The weather data were taken from the records of the St. Paul weather station.

Forty-nine of the House Sparrows were banded with colored bands, and four others had natural marks that allowed the identification of 53 individuals. These marked birds showed that the individuals using the feeding station were from several flocks. These flocks were usually composed of from 5 to 15 birds, although larger groups were seen occasionally. The birds apparently traveled considerable distances, as one individual appearing at the feeding station frequently was also observed feeding at a riding stable about 0.9 miles away.

So far as was possible, the number of House Sparrows on the feeding station was recorded at 15-minute intervals throughout the day. The first observation of the day was usually made about a half hour before sunrise and the last about a half hour after sunset. Some 3,328 counts were made, totaling 12,848 bird observations. Since the day length during the period of study varied from about 8 hours and 32 minutes to about 12 hours and 39 minutes, it was not possible to make direct chronological comparisons. To make these comparisons, the period between sunrise and sunset was divided arbitrarily into 15 equal parts, and all observations falling within one of these periods were averaged.

In order to establish a base from which to compare the feeding patterns during extremes in weather conditions and day length, the entire set of observations were combined by period of the day (see Figure 1).

A small number of birds, usually singles or groups of twos or threes, arrived at the feeding station a little before sunrise. Shortly after sunrise the flocks would arrive, and the morning peak was reached immediately. The average number of birds at the station then decreased steadily

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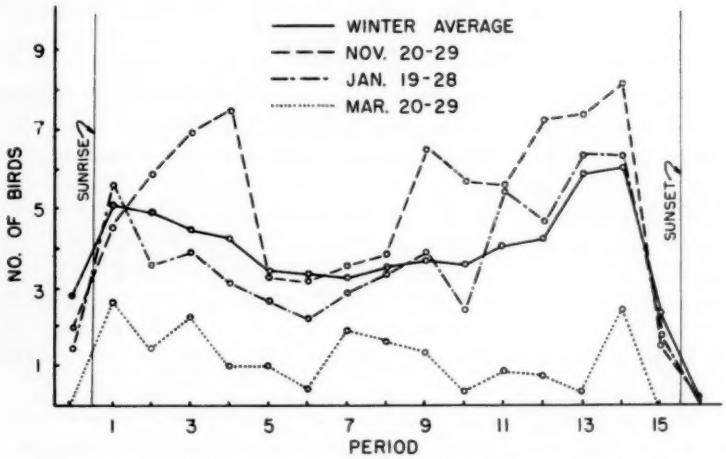


**Figure 1. Average number of birds observed on the feeding station during each period of the day for the entire winter and the intervals of 20 to 29 November, 19 to 28 January, and 20 to 29 March. The curve for the winter average is based on 3,328 counts with 12,848 bird observations. The 20-29 November curve is based on 234 counts with 1,230 bird observations. Not less than 10 counts were made for any period. The 19-28 January curve is based on 275 counts with 1,038 bird observations. Not less than 11 counts were made for any period. The 20-29 March curve is based on 185 counts with 219 bird observations. Not less than 6 counts were made for any period.**

through the fifth period, with the lowest number of birds being found during the seventh period. This was followed by a gradual increase in feeding activity through the 12th period. A sharp increase in numbers came during the 13th period, with the afternoon peak being reached in the 14th period. Only about a third as many birds remained feeding during the 15th period as in the preceding one. Only occasionally did a bird remain after sunset. During the winter the House Sparrows fed throughout the day, with the morning and evening peaks being only 1.6 and 1.9 times as great, respectively, as the midday low.

While intensity of feeding was not measured, it was evident that it was greater among those birds on the station during the peak periods than during the midday low. Those birds arriving before sunrise and those remaining after the afternoon peak were usually voracious feeders.

It is difficult to separate the several factors that have modifying effects on winter feeding habits. However, by taking a large series of observations, one can show trends, even though the absolute amounts of change

in relation to a given factor cannot be determined. To facilitate the analysis of the data in relation to day length and season, the total period was divided into 10-day intervals. The average number of birds present per observation for each period was calculated for each of these intervals. Three 10-day intervals were selected for comparison. These typify the short day intervals of early winter and midwinter and the longer day intervals of late winter. The undescribed intervals between these change gradually from one to the other.

During the first series of observations (see Figure 1), 20 to 29 November, with an average of about nine hours between sunrise and sunset, the morning peak came during the fourth feeding period following a steady build-up that started just before sunrise. This was followed by an abrupt drop to the midday low in feeding activity. The curve for the morning peak contrasts with the winter average, in that build-up was more gradual and the decrease to the midday low in feeding activity was abrupt. The midday low was also relatively lower and of shorter duration than that for the all-winter average. An early afternoon peak in number of birds came during the ninth feeding period, followed by a minor drop and then an increase to the afternoon peak during the 14th period. The build-up to the afternoon peak and the subsequent drop followed the same pattern as that of the winter average, except that there were only about a fifth as many birds present during the 15th as during the 14th period.

The 19 to 28 January interval, with an average of about 9 hours and 20 minutes between sunrise and sunset, contrasts with the November period of similar day length primarily in that the morning peak comes abruptly as in the all-winter average. An indication of a possible ninth-period peak is also present here. The late-afternoon peak is somewhat more pronounced than that of the early-winter period.

The 20 to 29 March interval typifies the longer day periods of late winter. These periods differ from the short day intervals and the all-winter average in that there are three feeding peaks with well-defined troughs between them. There is also a considerably shorter period of intense feeding activity during the early morning and late afternoon. The feeding during the long day intervals is also more leisurely and erratic.

The differences observed between the early- and midwinter intervals undoubtedly reflect changes in the daily temperature. The differences seen between the early- and late-winter periods, where the average daily temperatures were not greatly different, are undoubtedly due to the increased length of the feeding period.

In order to facilitate the analysis of the temperature data, the average temperature for each day was calculated. The data were then grouped in six categories covering about 5.5 degrees C each. The average daily temperatures varied from —25 to 6° C. The groups of data from days having —25 to 21° C, —14 to —9° C, and —3 to 2° C are summarized in Figure 2 and will be discussed in detail.

When the temperatures averaged between —3 and 2° C, the birds started arriving at the feeding station a little before sunrise and reached a morning peak during the first feeding period. The number of birds feeding dropped off some after this morning peak and was then somewhat erratic until in the late afternoon. The late-afternoon peak came during the 13th and 14th periods. Nearly all of the birds were gone during the 15th period, and none was seen after sunset. The feeding pattern for the day differed from the winter average in that the morning peak was relatively lower and in that the midday low in numbers came immediately before the afternoon high in feeding activity. During these

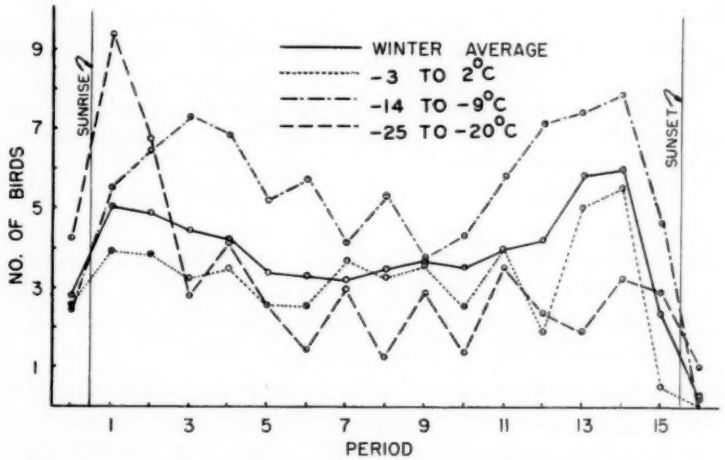


**Figure 2. Average number of birds observed on the feeding station during each period of the day for the entire winter and for those days having average temperatures of —3 to 2° C, —14 to —9° C, and —25 to —20° C. The curve for those days averaging from —3 to 2° C is based on 604 counts with 2,029 bird observations. Not less than 21 counts were made for any period. The curve for those days averaging from —14 to —9° C is based on 841 counts with 4,809 bird observations. Not less than 38 counts were made for any period. The curve for those days averaging from —25 to —20° C is based on 274 counts with 945 bird observations. Not less than 16 counts were made for any period.**

relatively warm days, with the exception of during the late-afternoon peak, feeding was rather leisurely and somewhat erratic. The individual birds would land on the feeding station and feed for a minute or so and leave. Sometimes they would leave the area and at others just land in the nearest tree to preen and dress their feathers. While on the feeding station there was considerable squabbling and fighting.

During those days when the average temperature was between —14 and —9° C, the birds started arriving just before sunrise, followed by a steady build-up until the morning peak was reached during the third feeding period. This was followed by a well-defined midday low. The afternoon build-up in numbers started to develop during the 10th feeding period and reached its peak during the 14th feeding period. This feeding pattern varied from the one just described in that the morning feeding peak was more pronounced and continued to build up until the third feeding period instead of dropping after the first period. The afternoon feeding peak started about two feeding periods earlier than during the warmer period and did not quit as abruptly after the maximum was reached during the 14th feeding period. The feeding pattern differed from the winter average in that the morning and afternoon peaks were relatively higher. During the days with an average temperature of between —3 and 2° C, only an occasional bird was seen on the station during the last period before sunset, while during the days averaging between —14 and —9° C, there were as many birds as were usually seen during the midday low. Also birds were occasionally seen after sunset. Feeding intensity differed from that of the warmer days in that feeding during the morning and afternoon peaks was a little more intense.

The feeding pattern during the days that averaged between —9 and —4° C and —21 and —15° C was quite similar to that observed on days averaging between —17 and —9° C.

During the coldest days, when the average temperature ranged from —25 to —21° C, birds started arriving at the feeding station as soon as it was light enough to see. Thus there was a considerable number of birds feeding by sunrise. Peak numbers of birds were reached during the first feeding period. There then was a steady drop in numbers until the sixth feeding period and by erratic occurrence at the feeding station throughout the rest of the day with only a slight tendency toward an afternoon feeding peak. A few birds were usually seen at the feeding station after sunset. This feeding curve varied from the others in that the major feeding period was during the early morning and in that there was but a slight indication of the usual afternoon peak. Also birds were commonly seen after sunset. The behavior of the birds was also con-

siderably different when they were on the station. They fed constantly and paid very little attention to each other. When they finished feeding, they flew to the nearest tree and sat quietly with their feathers fluffed out. They seldom moved until ready to feed again.

Two birds with leg and one with wing injuries were observed during the early part of the study. These all disappeared by the time the average daily temperatures reached —20° C. Direct injury to the birds did not appear until minimum temperatures reached about —29° C. On four occasions, birds were seen on the station with what appeared to be frozen eyes. The eye appeared white, and the lid was not closed over it. These birds, two of which were banded, failed to reappear at the station. Two birds were observed to freeze to death on the feeding station. This occurred in the latter part of January, when the minimum temperatures for the day reached —31 and —32° C, respectively. These birds arrived at the station before sunrise and started to feed immediately. However, their feeding activity lacked its usual vigor, and they would sit with their feathers fluffed out more than the other birds. After about an hour on the station, they ceased to feed and then sat quietly with their eyes partially closed until they died.

Observations, although not in as much detail as those on temperature and day length, were made on the effect of wind, rain, and snow on feeding behavior. When the feeding station was exposed to the wind, the birds would arrive at the station as usual but would feed rapidly and leave for more protected areas. This was the case even during the warmer days. Rain also caused the birds to feed rapidly and leave the station. Fighting and loafing on and near the station were curtailed by both of these factors. Snow appeared to have no effect on the birds' activity except to restrict the areas available for feeding. Except for the very few days when the average daily temperature was above 2° C, the ground was covered with snow. During these warmer days, the birds would feed a little at one area and move on to another. For this reason, too few observations were made to discuss this temperature range.

The birds that were observed at the station after sunset usually showed abnormal behavior, and it was assumed that these birds were sick. One marked bird was observed at the station after sunset for two days in a row, skipped one day and was observed again on the fourth day after sunset. This individual was not seen again. Throughout the winter, there was a steady decline in the average number of birds observed on the feeding station (see Figure 3). It is probable that much of this decline is due to mortality. If so, this is a high rate and may not be typical for the area as a whole.

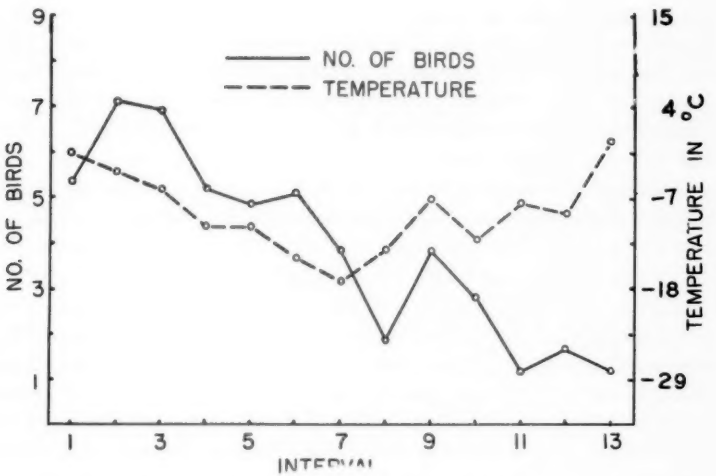


**Figure 3. The average temperature per interval and the average number of birds per observation for each interval.**

## Discussion

The critical temperature at which the House Sparrows' metabolic rate is at a minimum has been shown to be about 37° C (Kendeigh, 1944). At temperatures below this point, the birds are able to maintain themselves without increased food intake by increasing their insulation until the temperature drops to about 15° C (Steen, 1958). At temperatures below 15° C, the metabolic rate increases as the environmental temperature drops. Rowan (1925) showed that juncos were unable to gather enough food to survive when the temperatures dropped to —47° C. Kendeigh (1949) believed that the House Sparrow reached its maximum rate of energy intake at about —20° C. Stevenson (1933) showed that Song Sparrows and Field Sparrows with full stomachs will void the last of this material in from 2.2 to 2.5 hours. After this period, a bird would either have to obtain a new supply of food or live off its body reserves. Baldwin and Kendeigh (1955) have shown that this takes place, since there is considerable daily variation in body weight of small birds. The maximum weight is reached during the late afternoon. This stored energy is used during the night, and the minimum weight is reached by early morning when feeding starts again. Wild birds are also heavier in the winter than in the summer, and this additional weight gives them a greater reserve during periods of extreme cold stress.

To help conserve this energy, the metabolic rate and body temperature of birds normally drop at night (Benedict and Fox, 1933, and Miller, 1939). Steen (1958) concluded that birds subjected to extremely cold weather survive the long winter night by balling up and remaining motionless to conserve heat and by elevating their metabolism and lowering their body temperature.

Kendeigh (1944) found that House Sparrows were able to tolerate extremely low temperatures (presumably between —30 and —40° C and in the postabsorptive state) for only about six hours, after which there was a rapid decline in metabolism resulting in death.

During the present study, the period between sunrise and sunset, which is usually slightly longer than the period during which most of the birds are active, varied from about 8 hours and 32 minutes to about 12 hours and 39 minutes. During January, when most of the very cold weather occurred, the period between sunrise and sunset ranged from 8 hours and 40 minutes to 9 hours and 45 minutes. Thus, the birds had to survive from about 14 to 15 hours without obtaining food and probably from 12 to 13 hours in the postabsorptive state.

Baldwin and Kendeigh (1938) showed that during July small birds have a major feeding period in the morning and a minor feeding period in the late afternoon. There was very little feeding during the middle of the day. During the winter, there are two major feeding periods, with the afternoon period being the time of greatest feeding activity. There was also fairly heavy feeding during the middle of the day. It was only when the average daily temperature dropped below —20° C that the major feeding activity came in the morning. It appears that these shifts in feeding patterns allow the birds to obtain the amount of energy required for survival.

Kendeigh (1949) has shown that the gross energy intake increases as a straight line with decrease in temperature until temperatures as low as —30° C are reached. However, the completeness of digestion and absorption decreases with the quantity of food ingested (Brody, 1945). When existing under starvation conditions, birds die with higher body weights when exposed to very low temperatures than when exposed to higher temperatures (Kendeigh, 1934). This is probably due to the fact that food reserves cannot be made available fast enough to maintain the body temperature at the lower environmental temperatures.

Most studies have either involved the effect of temperature on the rate of food intake and degree of digestion or on the survival time while the bird is in the postabsorptive state. The information from these laboratory studies indicates that if the House Sparrows were exposed

continuously to the low environmental temperatures often found in this region, they could not survive. However, the birds hunt for protected areas in which to roost and loaf and thus avoid these extremely low temperatures during much of the day.

When the average daily temperature drops below about —20° C, the daily feeding pattern shifts considerably from that seen at higher temperatures. It would appear that considerable stress is placed on the House Sparrows and that this is probably approaching the limit of their temperature tolerance.

## SUMMARY

Between 20 November 1949 and 31 March 1950, 3,328 observations were made of House Sparrows on a feeding station. Typically, the birds started feeding at about sunrise and reached a morning peak soon thereafter. Feeding was somewhat erratic during the middle of the day, with a second feeding peak coming about an hour before sunset.

At average daily temperatures of below —20° C, the major feeding peak took place early in the morning, with the birds starting to feed well before sunrise. At these colder temperatures there was little build-up in the afternoon, although individuals did not leave the station until well after sunset.

Rain and wind caused a decrease in feeding activity.

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# ECOLOGICAL ASPECTS OF THE BLUE-SNOW GOOSE COMPLEX

GRAHAM COOCH

THE taxonomic relationship of the Blue Goose *(Chen caerulescens caerulescens)* and the Lesser Snow Goose *(Chen hyperborea hyperborea)* has long created controversy among avian systematists, *e.g.*, Blaauw (1908), Soper (1930), Sutton (1932), Manning (1942), and Manning *et al.* (1956). I believe that the two forms are conspecific and that the species consists of two subspecies: a large form, *Chen caerulescens atlantica*, which has no color phases, and a smaller form, *Chen caerulescens caerulescens*, which is polymorphic and has two clearly defined color phases. The remainder of the discussion is concerned only with the latter race.

Because of slight pleiotropic differences between the phases, reflected especially in nesting and incubation behavior, some may prefer to follow the lead of Manning *et al.* (1956) and confer subspecific status on *hyperborea*. However, my opinion is that such differences should be considered as dichromatic polymorphs of a single subspecies *Chen c. caerulescens*.

The genetic basis of these color phases is at yet incompletely known and will not be stressed here (cf. Cooch and Beardmore, 1959). Color phases are common among arctic vertebrates and in this case appear to be a form of adaptive polymorphism, which under present climatological conditions gives some selective advantages to blue-phase birds. I shall attempt to define some of the ecological factors influencing the genetic shift toward blue-phase birds.

## DISTRIBUTION

The distribution of the 14 main breeding concentrations is shown in Figure 1. All are located on flat, palaeozoic basins, drained by braided deltas and within five miles of salt water, with the exception of Egg River, Banks Island, which is 16 miles inland (McEwen, 1958).

The percentage of blue-phase birds within any given population is presently greatest at Bowman Bay, Baffin Island, but is increasing rapidly elsewhere, especially within the Hudson Bay drainage. For example, in 1940 the percentages of blue-phase at each colony were as follows: Bowman Bay, 95; Cape Dominion, 50; Koukdjuak, 20; Boas River, 10; Eskimo Point, trace; Perry River, trace. In 1959 the percentages were: Bowman Bay, 97; Cape Dominion, 85; Koukdjuak, 50; East Bay, 35;

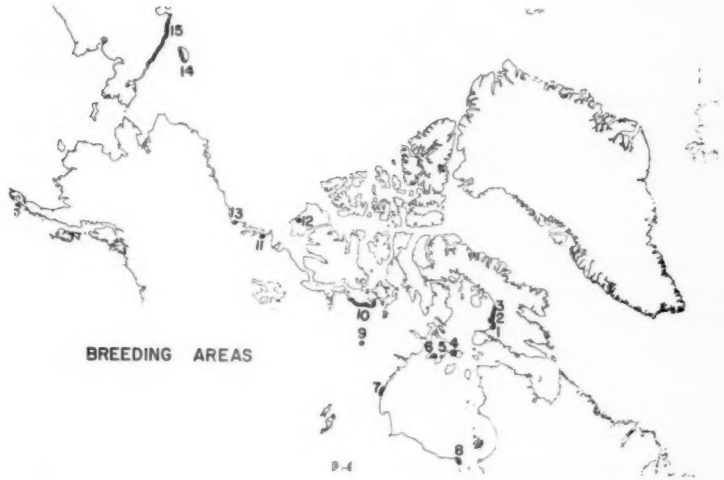


**Figure 1. Location of known major breeding concentrations of *Chen caerulescens caerulescens*. Localities are identified in Table 1.**

Boas River, 30; Eskimo Point, 15; Perry River, 9; Banks Island, trace. Evidence of the westward extension of blue genes is the increased number of blue-phase geese reported in migration in recent years from Alberta and California. Details of the recent distributional changes will be presented elsewhere (Cooch, 1960 MS), concomitantly with a discussion of introgression between the phases.

## PLUMAGE

Plumage color within populations of *Chen c. caerulescens* ranges from white-phase, having six dark primaries and white alulae, to extremely melanistic blue-phase geese. The extent of this variation is most easily detected at colonies such as Boas River, where both phases are relatively common. In white-phase birds, a cline of decreasing frequency of dark alulae can be detected northward and westward from Bowman Bay, similar in nature to the blue to white cline mentioned above. Dark alulae seem to be the first indication of the presence of blue genes in what otherwise would appear to be a pure population of white-phase *caerulescens*.

## PAIRING

Pairing between phases is common but not random (Cooch and Beardmore, 1959). Progeny from all types of mating are equally viable, and

no difference in egg fertility has been detected. In areas where predominately blue-phase birds have apparently only recently penetrated, adult male heterozygous blues (white-bellied) mated to dark-alulaed white-phase females have pioneered. In most breeding areas where the populations are mixed and blues are in the minority, blue-phase individuals are increasing within those populations at a rate of from 1 to 2 per cent per annum.

## NESTING

No differences have been detected between the phases with regard to the selection of nesting sites, manner of construction, or defense (Cooch, 1958). Clutch sizes before predation and other loss are identical, averaging 4.42 eggs per complete attempt for both phases under comparable phenological conditions. This is referred to as the theoretical clutch size, since it would occur only in situations where no egg loss occurred.

Since blue- and white-phase birds are differentially affected by varying phenology, the nature of the nest-initiation curves is of utmost importance in analyzing the observed increase of blue-phase birds. *Chen c. caerulescens* constructs nests over a 10-day period, regardless of the phenology of the season, and 12 days after the first nest has been completed and laid in, all laying is terminated. Both phases begin and end their egg-laying activities within the same 12-day interval.

However, the nature of the nesting curve in terms of new nests begun and eggs laid is different for the two phases under differing phenological conditions. Three types of nesting curves are presented in Figure 2, representing early (4–7 June, *e.g.*, 1952), "normal" (8–11 June, *e.g.*, 1953), and late or retarded (12–16 June, *e.g.*, 1957, 1959) seasons. The three curves in Figure 2 are based on all nesting attempts, regardless of phase. The difference between the phases in mean date of nest initiation in retarded seasons is similar to that depicted in Figure 2, if 1957 represents white-phase and 1952 blue-phase nesting attempts. Data in Table 2 indicate that the increase in activity in the first part of a retarded season is clear cut, and the results of such activity will be apparent later in the paper. Throughout the investigation it has been evident that white-phase birds tend to nest earlier than do blue-phase birds except in a very early season (1952).

In itself, this variation is interesting. But its importance lies in the fact that predation and other forms of nesting loss are greatest early in the season and then quickly subside (Cooch, 1956). At Eskimo Point in 1959, 100 per cent of all eggs laid on the first two days of the nest-initiation period were destroyed by Parasitic Jaegers (*Stercorarius parasiticus*) or by flooding. Since white-phase birds tend to nest earlier than

TABLE 1

SIZE AND POPULATION OF THE MAJOR BREEDING GROUNDS OF *Chen caerulescens caerulescens*

| *Locality** | *Latitude* | *Longitude* | *Sq. miles* | *Population* | *% blue phase* |
|---|---|---|---|---|---|
| 1 Bowman Bay | 65°20′ N | 73°35′ W | 250 | 165,000 | 97 |
| 2 Cape Dominion | 65°50′ N | 74° W | 240 | 100,000 | 85 |
| 3 Koukdjuak | 66°20′ N | 73°55′ W | 200 | 75,000 | 50 |
| 4 East Bay | 64° 0′ N | 82°10′ W | 20 | 20,000 | 35 |
| 5 Bear Cove | 63°40′ N | 84°45′ W | 1 | 1,000 | 30 |
| 6 Boas River | 63°42′ N | 85°45′ W | 30 | 25,000 | 30 |
| 7 Eskimo Point | 60°30′ N | 94°50′ W | 25 | 15,000 | 14 |
| 8 Cape Henrietta Maria | 55°10′ N | 82°50′ W | ? | 25,000 | ? |
| 9 Beverly Lake | 64°50′ N | 100°10′ W | ? | ? | ? |
| 10 Perry River | 67°50′ N | 102° W | ? | ? | 9 |
| 11 Anderson River | 69°50′ N | 129° W | ? | 5,000 | 0 |
| 12 Egg River | 71°50′ N | 124°50′ W | 16 | 20,000 | TR |
| 13 Kendall Island | 69°10′ N | 136° W | 2 | 5,000 | 0 |
| 14 Wrangel Island | 72° N | 180° W | ? | ? | 0 |
| 15 Siberia | 70° N | 180° W | ? | ? | 0 |

* Numbers before localities refer to the position of these localities on Figure 1.

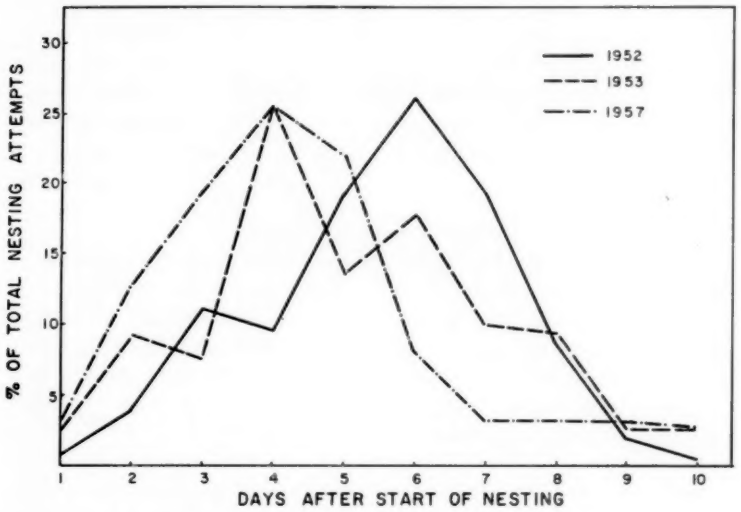


**Figure 2. Number of nesting attempts started on each day of nest initiation period expressed as a per cent of total attempts—data for both phases are combined.**

TABLE 2

VARIATION IN MEAN DATE OF NEST INITIATION MEASURED IN NUMBER OF DAYS AFTER FIRST NESTING ATTEMPT

| *Year* | *Pair* | *First nest* | *No.* | *Mean* | *S.D.* |
|---|---|---|---|---|---|
| 1952 | SXS | 4 June | 172 | 5.5 | 1.77 |
| 1953 | SXS | 9 June | 105 | 4.0 | 2.28 |
| 1959 | SXS | 8 June* | 238 | 3.7 | 1.92 |
| 1952 | BXB | 4 June | 65 | 5.4 | 1.67 |
| 1953 | BXB | 9 June | 11 | 4.7 | 1.96 |
| 1959 | BXB | 8 June* | 42 | 4.6 | 1.83 |

* Data for 1952 and 1953 are from Boas River, for 1959, from Eskimo Point. At Eskimo Point 8 June is the phenological equivalent of 12 June at Boas River. Thus, the comparison of years 1952, 1953, and 1959 is effectively a comparison of early, normal, and retarded seasons.

do blue-phase birds, this would suggest that more nests and eggs of the former were destroyed. This does not take into account the number of nests completely destroyed, which increases in the same proportion. However, if a season is extremely retarded (after 14 June at Boas River), a higher proportion of white-phase birds is successful because of an inherent difference in the shape of the nesting curve exhibited by

the phases—during an early season 50 per cent of white-phase and 75 per cent of blue-phase birds nest within two days of the mean date of nest initiation. Complete disruption of a major portion of the nesting pairs would thus affect relatively more blue-phase birds.

Figure 3 shows the effect of retarded seasons on clutch sizes of successful nesting attempts of blue- and white-phase birds. In early seasons the nest-initiation curves are nearly identical, and egg losses are also in the same order of magnitude; but as seasons become more retarded, a higher proportion of eggs from white-phase birds are destroyed.

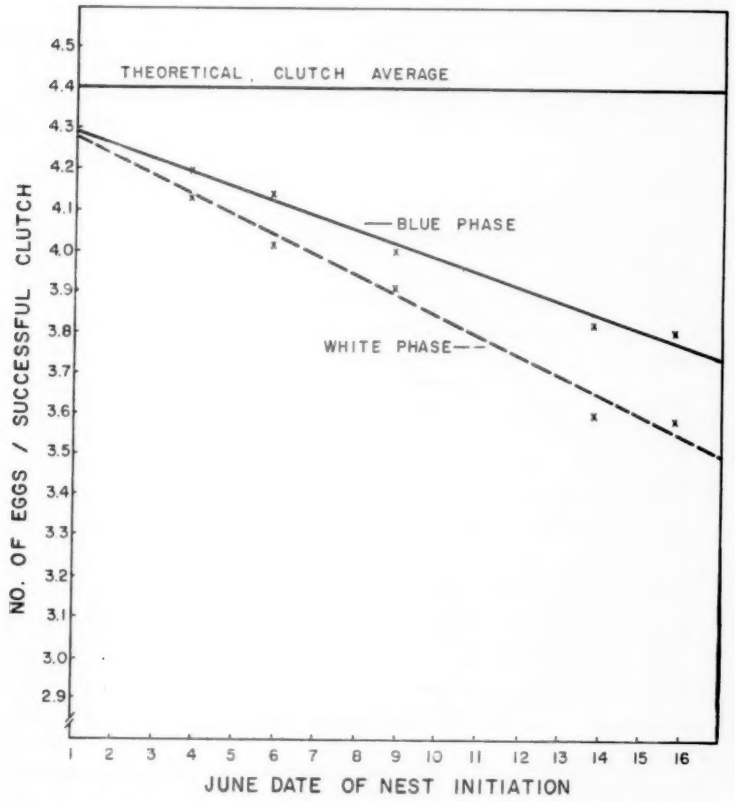


**Figure 3. Average number of eggs per successful clutch showing relationship between relative success of blue-phase and white-phase *caerulescens*, and successively later June date of nest initiation.**

Figure 4 represents the components of nesting loss in different seasons, based on a sample extrapolated to 1,000 eggs. The net effect of a retarded season appears to be that birds physiologically ready to nest early in the season are prevented from doing so because of weather or snow conditions. However, when extrinsic barriers are removed, competition for available nesting space is intensified, and all those birds still capable of nesting attempt to do so simultaneously. This frequently results in a breakdown of territoriality and leads to desertion and dumping of eggs in other nests, with concomitant decrease in intensity of nest defense. In short, in an early season (4 June) 190/1,000 eggs are

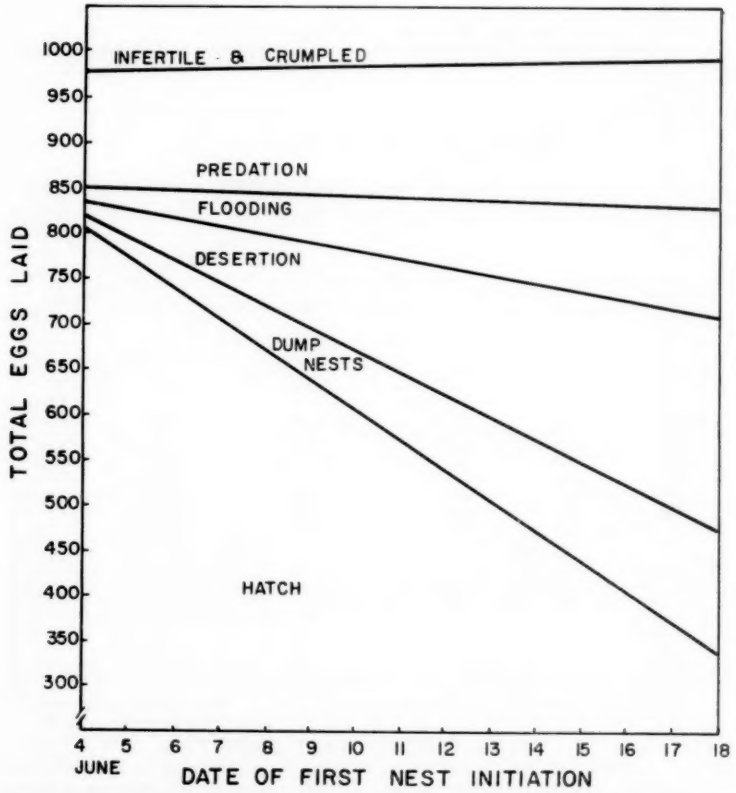


**Figure 4. Schematic presentation of components of nesting loss showing variation associated with variation in date of first nest initiation.**

destroyed before hatching, in a "normal" season (9 June) 365/1,000, and in a retarded season (13 June) 490/1,000. Complete destruction of a clutch causes the birds to enter their postnuptial molt earlier than do successful breeding pairs. No renesting is attempted, nor can it be induced (Cooch, 1958).

## Clutch Sizes

As stated previously, no difference exists between numbers of eggs laid by the various pairing arrangements (BXB, BXW, WXB, or WXW). Significant differences (6 vs. 3) were found, however, between clutches initiated early in the season and those initiated later. In retarded seasons there is less difference (4.8 vs. 3.0) between early and late clutches. Predation and other forms of nesting loss tend to reduce the difference but never obliterate it. In teleological terms, smaller clutches are "necessary" in retarded seasons or at the end of a normal season in order that reproduction be speeded up. Under optimum conditions, *caerulescens* has 105 days in which to complete its reproductive activities. In a retarded season, the last birds to start laying have only 83 days.

Lack (1947) has postulated several theories on the evolutionary significance of clutch size, based mainly on the premise that, in altricial species, availability of food during brood rearing is a limiting factor. In the case of *caerulescens* and its precocial young, that thesis does not seem to hold. Factors limiting brood size are related to mortality caused by the physical nature of the environment and predation.

Birds laying large clutches do not lay on consecutive days, but after the deposition of the fourth egg, tend to cease laying for two days. As a result nine days are required to lay seven eggs. The most important factor limiting brood size is the phenomenon of interrupted egg laying. Large clutches normally require two days to hatch, but in the event of inclement weather, three or more days may be required. The four eggs that were laid first hatch almost simultaneously. Frequently there is as much as a 96-hour difference in the ages of a seven-gosling brood. As a result, the first hatched are better able to keep up with the adults and do not straggle. The last hatched are weak, tend to straggle, and are unable to compete for brooding space with older members of the brood. The prognosis of survival for such goslings is poor.

There are some data based on serially marked eggs that strongly suggest that, in mixed pairing, white-phase progeny tend to hatch later in any given brood, and are therefore weaker and more susceptible to predation. These data are presented in Table 3. The observed decrease

in frequency of white-phase young in mixed broods as the season progresses is presented in Table 4. The decrease noted in the 10th week after hatching is partly attributable to selective hunting pressure south of the breeding grounds. Few mixed broods larger than four contain any white-phase young after the 10th week.

TABLE 3

RELATIVE PROPORTION OF WHITE-PHASE GOSLINGS HATCHING IN 64 SERIALLY MARKED, MIXED-CLUTCHES, BOAS RIVER, 1952, 1953

*Egg sequence*

| | | 1 | | 2 | | 3 | | 4 | | 5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Clutch size* | *N* | *B* | *W* | *B* | *W* | *B* | *W* | *B* | *W* | *B* | *W* | *% W* |
| 2 | 9 | 9 | 0 | 7 | 2 | | | | | | | 11.1 |
| 3 | 16 | 16 | 0 | 13 | 3 | 10 | 6 | | | | | 18.7 |
| 4 | 21 | 20 | 1 | 17 | 4 | 13 | 8 | 10 | 11 | | | 28.3 |
| 5 | 18 | 17 | 1 | 15 | 3 | 12 | 6 | 10 | 8 | 8 | 10 | 31.1 |
| Total | 64 | 62 | 2 | 52 | 12 | 35 | 20 | 20 | 19 | 8 | 10 | 26.2 |
| % White | | 3.1 | | 18.7 | | 36.3 | | 48.7 | | 55.5 | | |

B = Blue-phase gosling.
W = White-phase gosling.

TABLE 4

CHANGES IN PHASE COMPOSITION OF MIXED BROODS FROM TIME OF HATCHING UNTIL 12 WEEKS AFTER HATCHING, 1952

| *Time* | *Brood size* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Average | % White |
| Hatch | 0 | 1 | 3 | 16 | 12 | 1 | 0 | 0 | 4.22 | 25.5 |
| First week | 4 | 4 | 6 | 11 | 7 | 2 | 0 | 0 | 3.55 | 17.9 |
| Tenth week | 4 | 12 | 8 | 8 | 6 | 1 | 1 | 1 | 3.23 | 12.5 |
| Twelfth week | 3 | 8 | 8 | 6 | 5 | 2 | 0 | 0 | 3.33 | 11.3 |

The reduction in white-phase goslings in mixed broods is apparently one mechanism by which the percentage of blue-phase birds is increasing. The reverse occurs when both birds of a pair are white-phase geese having dark alulae and laying more than five eggs. In 54 cases observed at Boas River in 1952 and 1953, the last egg laid produced an atypical blue-phase gosling, which eventually became an extreme white-bellied blue-phase adult. The ability of such a gosling to survive the critical posthatch period is slight, and few if any blue goslings are produced by such pairs. Such cases are uncommon except where both phases are relatively abundant.

## AUTUMN MIGRATION

The direct differential effect of varying phenological conditions on nest initiation and reproductive success is one basic cause of the observed increase in the proportion of blue-phase birds. The date of nest initiation also affects autumn migration and produces predictable changes from the "norm" (Cooch, 1955), which may bear more heavily on one phase than the other.

Figure 5 shows the relationship between date of nest initiation and all other phenological events. Band recoveries indicate that in early breed-

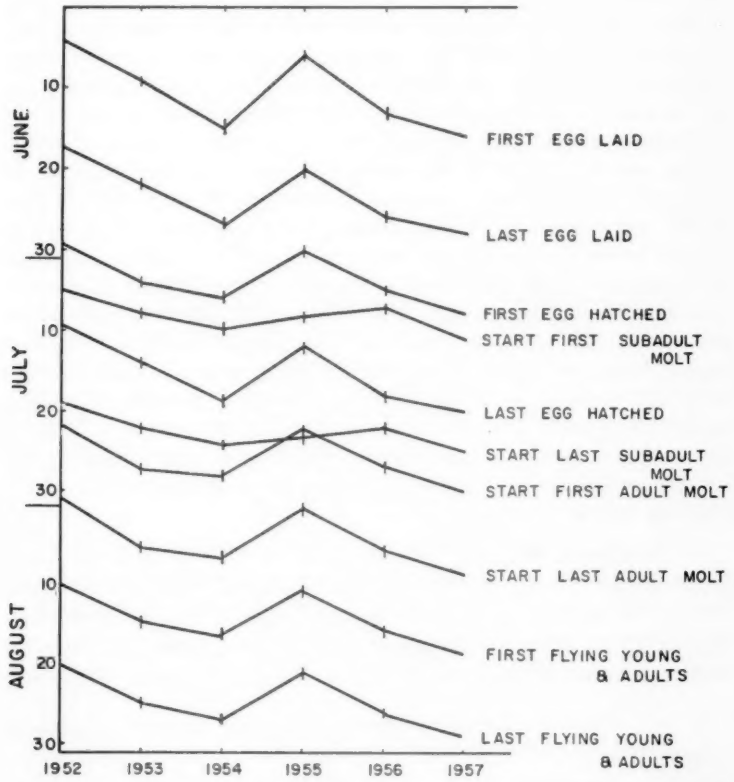


**Figure 5. Chronology of phenological events 1952–1957 showing the relationship between date of first egg laying and all other events happening on the breeding grounds.**

ing seasons individuals of *Chen caerulescens* breeding at Boas River make a nonstop flight from Hudson Bay to Gulf of Mexico. However, when seasons are retarded, a higher percentage of the population interrupts its migration in the midwestern United States. These data are given in Table 5, where recoveries of adult banded birds from northern states are expressed as a percentage of the total adult recoveries from the United States. In moderately retarded seasons, the rate of recovery for white-phase birds is greater than for blue-phase birds. In extremely retarded seasons, relatively more blue-phase birds are taken. This is apparently a result of the pattern of nest initiation: a high percentage of white-phase birds are geese that have failed to produce young that molt early, and that behave as subadults, *i.e.*, make a nonstop flight to the Gulf Coast. Because blue-phase birds nest a little later, some at least are always successful, but since they are retarded by phenological events, their migration is severely interrupted. Following a phenologically early season, approximately 25 per cent of the total population is removed by hunting pressure; but in retarded seasons, the kill increases to nearly 35 per cent, with most of the increment made up of birds shot in the midwestern United States. Because blue-phase birds are in the minority, but are increasing, adult cohorts contain fewer blue-phase birds than do younger cohorts. The increased attrition on breeding adults would speed up the process of eliminating white-phase birds even if hunting pressure were exerted randomly. Since 1952, 33 bands per hundred from white-phase adults have been returned for each 21 per hundred blue-phase bands. It has previously been shown that in the case of juveniles (which contain the highest proportion of blue-phase birds) white-phase goslings are selected against, both by natural and by hunting predation. This is an example of how man can influence the selection of a color phase by hunting pressure alone without changing the ecological aspect of the breeding habitat.

Another factor that influences the spread of blue genes is the distribution pattern of *caerulescens* during breeding, migration, and wintering. Perhaps the most important point is the behavior of the two phases during migration. Five primary aspects of migration apparently affect the recently observed shifts in the frequency of the blue genes. These are:

1. The relatively distinct routes used by the various populations (Figure 6).

2. The observed tendency of blue-phase birds during migration to filter eastward and white-phase birds to filter westward within the bounds of the population flyway.

TABLE 5

VARIATIONS IN THE NUMBER OF BANDS FROM ADULT BLUE-PHASE AND WHITE-PHASE GEESE RETURNED FROM THE UNITED STATES, 1952–1958

| Year | Date* June | *Northern United States* | | | | | | *Southern United States* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Blue* | | *White* | | *Combined* | | *Blue* | | *White* | | *Combined* | |
| | | *No.* | % | *No.* | % | *No.* | % | *No.* | % | *No.* | % | *No.* | % |
| 1952 | 4 | 0 | 00.0 | 2 | 11.0 | 2 | 5.0 | 22 | 100 | 16 | 90 | 38 | 95 |
| 1953 | 9 | 10 | 26.3 | 41 | 43.6 | 51 | 38.6 | 28 | 73.7 | 53 | 56.4 | 81 | 61.4 |
| 1954 | 14 | 30 | 66.6 | 85 | 59.0 | 115 | 60.8 | 15 | 33.3 | 59 | 41.0 | 74 | 39.2 |
| 1955 | 6 | 4 | 12.0 | 13 | 19.4 | 17 | 17.0 | 29 | 88.0 | 54 | 80.5 | 33 | 83.0 |
| 1956 | 12 | 19 | 65.5 | 46 | 55.3 | 65 | 58.0 | 10 | 34.5 | 37 | 44.7 | 47 | 42.0 |
| 1957 | 16 | 8 | 47.0 | 36 | 57 | 44 | 55.0 | 9 | 53.0 | 27 | 43.0 | 36 | 45.0 |
| 1958 | 12 | 12 | 50.0 | 74 | 69 | 86 | 65.5 | 12 | 50.0 | 33 | 31.0 | 45 | 34.4 |

* Date of first nest initiation.

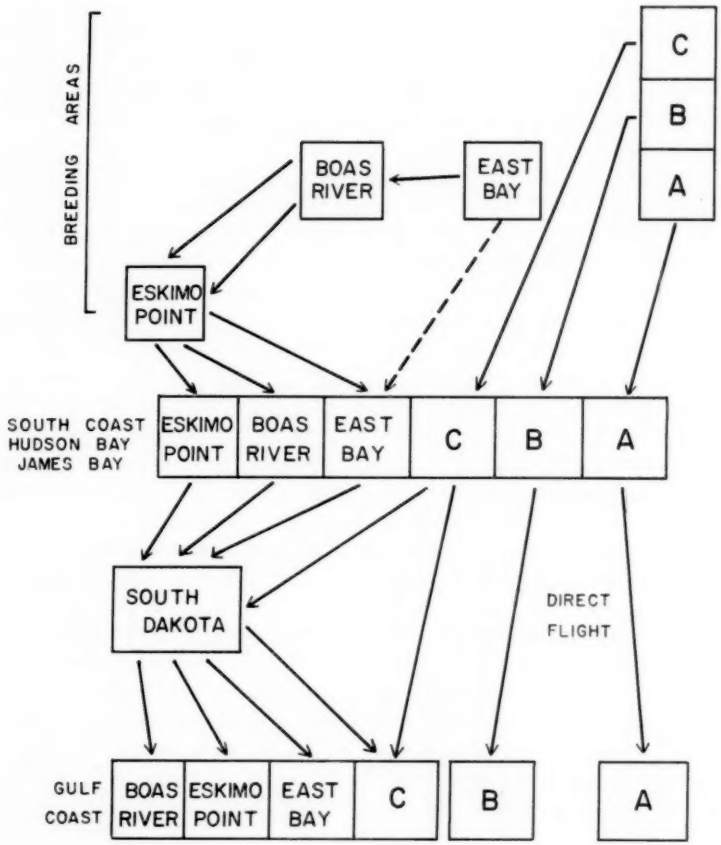


**Figure 6. A schematic presentation of migratory and wintering distribution of six populations of *Chen c. caerulescens* from the Hudson Bay drainage. A = Bowman Bay; B = Cape Dominion; C = Koukdjuak.**

3. The tendency of blue-phase birds to make a nonstop flight from James Bay and Hudson Bay to the Gulf of Mexico more frequently than white-phase birds.

4. A greater hunter preference for white-phase birds.

5. Differences in migratory pattern associated with age, breeding success, and phenology.

The first two factors are isolating mechanisms that impede the rapid exchange of genes from one population to another, while the last three factors tend to contribute to selection pressure.

The cline of increasing blue and decreasing white to the north and to the west of Bowman Bay is difficult to explain unless migration by breeding population is considered. Apparently, predominately blue-phase geese have appeared only recently (possibly within the past 50 years) outside of the Baffin Island breeding areas. Salomonsen (1954) has summarized the various types of gene flow, showing lucidly how barriers to the spread of a particular gene need not necessarily be physical, spatial, or behavioral. In the case of *Chen c. caerulescens*, the spread of blue genes was impeded by the intrusion of other populations from Baffin Island, between Bowman Bay, and the breeding and wintering populations from Southampton Island and mainland colonies to the west (Figure 6). Before blue genes from Baffin Island were able to reach Southampton Island, they had to work their way north along the Foxe Basin coast of Baffin Island. This process required not a single generation, but gene movement through a number of generations of geese. This was possible only with an amelioration in climate such as witnessed in the past 50 years. In arctic Canada, this amelioration is mostly found east of a line that runs roughly parallel to the west coast of Hudson Bay (cf. Hare, 1955; Ahlmann, 1955; Willett, 1950; and Lysgaard, 1950). Although both phases begin and end their nesting activity in the same 12-day period, the relative success of white-phase birds in extremely retarded seasons would imply that northward extension of blue genes was inhibited until climatic amelioration occurred. In addition, white-phase birds have a shorter incubation period (23.1 days vs. 23.6 days) than do blue-phase birds, and in regions where the length of the breeding season is reduced, this difference would confer an additional advantage to white-phase birds. The more northerly distribution of white-phase birds presently in existence might be taken as an indication that they are still better adapted for a rigorous environment.

Because geese have strong familial ties and during the first year at least these familial ties remain intact, there is reduced opportunity for new genes to be introduced into any population by the progeny from any given breeding season. Adults that have previously nested in a given area return to that area to breed in successive years (Cooch, 1958). If the parents survive, their progeny also return, at least in their second year. Since *caerulescens* require two and possibly three years to reach sexual maturity, only those three-year-old individuals that have just reached breeding age or those two-year-old birds that have lost their parents are

likely to wander to new areas. Such action by three-year-olds is, however, unlikely, since, during their first summer on the breeding grounds, subadults remain with their parents until the first stages of incubation, then molt on the periphery of the breeding colony. There they associate with second-year and failed-breeding adults. That cohort of the population migrates in mid-August and reaches the wintering areas in early October. Band recoveries from subadults have the same distributional pattern as those from adults and young banded at the same colony. In nearly all extracolonial shifting recorded to date (149/184), birds banded as locals have been involved. This is especially true in shifting between Eskimo Point and Perry River (7/7). Whether the shift occurred when the birds were subadults or of breeding age is not known. Band recoveries from the breeding grounds indicate that fewer than one band in 1,000 will be recovered from an area other than that where it was originally attached. This would indicate that each breeding population is relatively discrete. A larger gene flow can be expected from a continuous colony such as exists along the Foxe Basin coast. However, populations or segments of populations tend to resist movement from one locus into other loci.

Because of this conservatism, the Cape Dominion and Koukdjuak populations acted as a barrier to the spread of blue genes to Southampton Island until frequency of the genes in those populations had reached a level whereby a relatively high proportion of heterozygotes was available for emigration. It will be noted that the Koukdjuak population in winter is only partially allohemic with regard to the East Bay and Southampton Island populations. Once blue-phase birds reached the northern limit of the Baffin Island breeding area in numbers, they were then able to drift over into the East Bay population through association during migration and on the wintering grounds. Once that was accomplished, a major barrier to the spread of blue genes had been overcome.

A second factor that tends to act as an isolating mechanism for blue genes may be described as an observed tendency for like to attract like, especially during migration. This is also of importance on the breeding grounds and would have delayed the northward spread of blue genes on Baffin Island into regions of white abundance. It has been observed at Eskimo Point, Perry River, and Banks Island, that the first blue-phase individuals to colonize a new area are white-bellied blue-phase males mated to white-phase females (mostly with dark alulae). The latter are probably the true pioneers, but being predominately white-phase would not generally be detectable. All known westward shifting from Eskimo Point to Perry River has involved white-phase birds whose alulae color

is unknown. As pointed out previously, a pair of dark alulaed white-phase birds having a large clutch (more than 4) are capable of producing an extreme white-bellied blue-phase gosling. It is thus within the realm of possibility that the heterozygotes involved in pioneering have actually been products of this pairing arrangement. This fact in no way changes previous arguments that the frequency of blue genes had to be relatively great before successful emigration could occur.

The fact that like tend to attract like has been clearly demonstrated in band recoveries from the Boas River population. In 1952 and 1953, a total of 13,400 geese were banded there in the ratio of 1 blue-phase to 2.4 white-phase. These birds migrate first to the south coast of Hudson Bay and are hunted from York Factory, Manitoba, eastward to Cape Henrietta Maria, Ontario; few are taken within James Bay proper. As one proceeds east from York Factory, the ratio steadily decreases from 1:2.4 to 1:2.1 at Severn, to 1:1.8 at Winisk, and 1:1 in James Bay. During migration through the United States, recoveries east of the Mississippi are in the ratio of 1:0.8 blue to white, and west of the Mississippi, the ratio is 1:4.0 blue to white. Along the wintering grounds, ratios change from 1:0.5 blue to white at the mouth of the Mississippi River, to 1:2.4 in east Texas, to 1:9.0 in Cameron County, Texas. The greatest rate of band return comes from east Texas, where birds are taken in the same ratio as they occur in the banded population. Segregation on the wintering grounds is important because coastal marshes of Louisiana are relatively less accessible than those of Texas. Blue-phase geese that tend to filter east therefore receive less hunting pressure than do white-phase birds that filter west along the Texas coast. As a result, white-phase birds again tend to be removed from the population at a faster rate than do the blue-phase birds.

## ACKNOWLEDGMENTS

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SUMMARY

Blue Geese *(Chen c. caerulescens)* breed in 14 major concentrations from Baffin Island to Siberia. Blue Geese and Lesser Snow Geese *(Chen h. hyperborea)* are considered to be conspecific and color phases of *Chen c. caerulescens*. The center of blue-phase abundance is at Bowman Bay, Baffin Island, but the frequency of blue genes is increasing rapidly, especially in the Hudson Bay drainage. This increase is considered to be an example of adaptive polymorphism, which under present conditions favors blue-phase birds. Mixed pairing occurs but is not random. Progeny from mixed pairs are predominately blue-phase and follow Mendelian segregation. Selection pressure in mixed broods is greatest against white-phase goslings, but equal in pure broods of either phase.

No behavioral differences are noted between the phases, but there are slight differences in the nature of the nesting curve, which in some seasons selects against white-phase birds. Basic clutch size is 4.42, but the number of eggs surviving to hatching time is dependent upon the phenology of the season. A factor limiting brood size is interrupted egg laying and resulting differences in age of goslings within the brood. Since, in mixed clutches, the white-phase tend to be laid last, they are the last hatched and thus less likely to survive. Both phases are more successful in early breeding seasons than in retarded ones, but blue-phase birds and mixed pairs are more successful than white-phase birds, except in extremely retarded seasons. Populations breed, migrate, and winter as discrete entities with little gene exchange. White-phase birds are more likely to exhibit an interrupted migration and are therefore more frequently available to hunters in the United States.

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## GENERAL NOTES

**Observations of Pellet-Casting by Horned and Pied-billed Grebes.**—In his interesting article "Feather-eating and Pellet-formation in the Great Crested Grebe" (*Brit. Birds*, 49: 432–435, 1956), Simmons summarizes the evidence for the theory that feathers eaten by grebes form the necessary rough material in which fish bones and other indigestible items can be ejected in the form of pellets. He goes on to say that "the pellet itself is unknown and no observer seems as yet to have witnessed the actual oral ejection of one. Thus the final and concrete proof of the connection between feather-eating and pellet-formation is still lacking."

I have been fortunate enough to witness pellet-casting by two species of grebe, the Horned (*Podiceps auritus*) and the Pied-billed (*Podilymbus podiceps*). Because of the apparent novelty of these observations, it seems worthwhile to describe them in some detail.

On 8 June 1957 I spent several hours watching a pair of Horned Grebes on Portage Creek (T 13 N, R 6 W, Sec. 17), a few miles south of Delta, Manitoba. The birds were bringing up what looked like dense masses of green algae roughly twice the size of their bills and appeared to be getting small particles of food from these masses before discarding the bulk of the algae. At 2:40 P.M., the male (larger and brighter than his mate, and with longer head plumes) started drinking repeatedly, dipping his bill into the water, raising it still partly opened, and then shaking his head once or twice. Three minutes later he coughed up a dark-green pellet, which appeared to be roughly three quarters of an inch long and one quarter of an inch in diameter. He then dipped his bill into the water and shook his head as though to clean his bill, and within two minutes he resumed diving for food. At 4:40 P.M. the same day, the female drank several times and acted as though she were casting a pellet, but she was so far away that I could not be positive that she had done so.

On 24 April 1960 I spent approximately seven hours watching a pair of Pied-billed Grebes on Jemmerson Slough, a small, fishless body of water two miles west of the town of Spirit Lake, Dickinson County, Iowa. The pair was building a nest, but no eggs had as yet been laid. After diving for food from 3:16 to approximately 3:40 P.M., the female preened, oiled her plumage, and rested near some clumps of emergent vegetation until 3:59, when she swam out onto open water. There she made five drinking movements at intervals of from several to approximately 20 seconds. Then she coughed up a narrow, irregularly shaped, reddish pellet at least two inches long. Almost immediately afterwards she started diving for food.

Two points strike me as being significant in connection with these observations. First, in both instances the birds appeared to be taking a high proportion of indigestible material (algae, chitin) along with their food; and second, in both instances pellet-casting was preceded by drinking motions.

While it is now established that grebes do cast pellets, it has not as yet been possible to analyze the contents of these pellets, and the possible relation of the grebes' habit of feather-eating is still open to conjecture. One thing, however, can probably be stated with certainty; and that is that grebes whose diet is predominantly fish do not cast daily pellets of fish bones felted together with feathers from their own bodies. The following calculations indicate the improbability of this: The feather tracts on the breast and sides of a Red-necked Grebe (*Podiceps*

*grisegena)* consist of approximately 2,000 feathers, which would form well over one half of the bulk of feathers available for use in plucking for pellet formation. If we assume that only these feathers were used, that the birds cast one pellet per day, that this pellet contained 100 feathers (a not unreasonable number judging from the figure of the stomach contents of a Red-necked Grebe in Wetmore's account of *Food and Economic Relations of North American Grebes*, U.S. Dept. Agric. Bull. 1196: 8, 1924), and that these feathers take 20 days to attain full growth, each feather would be eaten as soon as it stopped growing, and the entire tracts would be in a perpetual state of molt. Even if the growth rate of these replacement feathers were double this and all the body feathers were involved, one fourth of the body feathers would be growing at any one time. I do not recall skinning a grebe that did not have numerous pin feathers, but none taken outside the seasons when regular molt is to be expected had anything like one fourth of the plumage growing. Indeed, it might be argued that such an amount of feather growth would be a serious drain on the energy resources of the bird, both through the actual formation of the feathers and in the reduction of the insulating and waterproof covering.

Nor is there any good evidence for regular plucking of feathers. Simmons *(Brit. Birds,* 49: 432, 1956) states that "adult Great Crested Grebes [*Podiceps cristatus*] seldom, if ever, deliberately pluck feathers for their own consumption though they sometimes do so when giving feathers to the young." My observations on the North American species of grebes are in agreement with his.

The bones of most fish consist largely of calcium carbonate, which is dissolved by hydrochloric acid in the stomach but presumably not in the alkaline environment of the small intestine. Hence, it is likely that a prime function of the swallowed feathers is to retain those bones in the stomach until they can be dissolved. A "built-in" device comparable to this feather mat is found in the anhingas. According to Garrod *(Proc. Zool. Soc. London,* 1876: 343) "the pyloric orifice in *Plotus* [ = *Anhinga*] *anhinga* . . . is protected by a mat of lengthy hair-like processes, much like cocoa-nut fibre, which nearly half fills the second stomach." Similar structures have been described by Garrod *(ibid.,* 1878: 680–681) for the African species *(A. rufa,* formerly known as *Plotus levaillanti)* and by Forbes *(ibid.,* 1882: 209–210) for the Indian species *(A. melanogaster).*

Hanzák *(Acta Mus. Natl. Pragae,* 8B: 32, 1952) mentions a record of the stomach contents of one Great Crested Grebe, which consisted of five fish, 6, 7, 8, 9, and 12 centimeters long. The bones from these fish, plus an equal mass of feathers, would make at least one large pellet. As these grebes have two regular feeding periods per day (one in the morning and one in the evening), two such pellets would probably be cast each day if the fish bones were not dissolved. The number of feathers required to make such a pellet, the acid environment of the stomach, and the lack of observations of pellet-casting in this species (which has probably been watched for more and longer periods than any other grebe), are all strong arguments against such frequent pellet-casting by fish-eating grebes.

On the other hand, chitin and vegetable matter, the latter taken incidentally in fish stomachs or attached to other animal food items, probably cannot be digested thoroughly by grebes. It is these types of material which I believe form the bulk of most grebe pellets. That feathers or hair may not be a necessary component of pellets is shown by the fact that some birds cast pellets containing none of these materials. For example, a Loggerhead Shrike *(Lanius ludovicianus)* kept in our laboratory for several weeks regularly cast pellets of grasshopper chitin held

together by mucus. However, the mushlike mass, consisting in part of broken-down feathers (see Hanzák, *op. cit.*, p. 34), found in some grebe stomachs probably is ejected with other indigestible material in the form of pellets. The condition of the feather fragments suggests that these feathers have remained in the stomach for considerable periods, and it is therefore likely that when grebes are feeding on fish, pellets may only be cast at intervals of several days.

To summarize, in the instances in which I have observed pellet-casting in grebes, the ejection was preceded by drinking motions and followed almost immediately by foraging. Feathers swallowed by grebes probably function to retain fish bones in the acid environment of the stomach where they may be at least partly dissolved. Pellet-casting is probably more frequent in grebes feeding on insects and other invertebrates than it is in those feeding on fish. The frequency with which pellets are cast and the proportion and significance of feathers in the pellets remain to be determined.

This study was supported by a National Science Foundation Research Grant (G-4846).—Robert W. Storer, *Museum of Zoology, The University of Michigan, Ann Arbor.*

**The Kestrel *(Falco tinnunculus)* in the New World.**—The Kestrel has wandered at least once to North America, where a specimen was collected at Strawberry Hill, near Nantasket, Massachusetts, on 29 September 1887, and we report here the second record for the New World and the first for the West Indies.

The bird from the West Indies was taken by hand in an exhausted condition on the street of the village of Le Carbet on the west coast of Martinique on 9 December 1959, and sent at once to one of us (R. P.) at Fort de France. It died very soon after and upon dissection was found to be extremely emaciated. It is an adult female with a wing length of 252 mm. The specimen was identified subsequently (by C. V.), who took it to New York to compare it with the series in the American Museum of Natural History. It belongs to the nominate race *(F. t. tinnunculus* Linnaeus), and its wing length matches closely the average wing length of the females of the nominate race from Europe, which measure 240–270 (253.8) in 20 adults. This specimen is now in the collection of the Collège Séminaire of Fort de France, Martinique, French West Indies.

The specimen from Massachusetts is in the collection of the Chicago Natural History Museum (number 37631) and came from the collection of C. B. Cory, where it had the catalogue number 11636. It is a female of the nominate race in juvenal plumage with a wing length of 236 mm. The conditions under which this specimen was taken are unknown to us, but we believe there can be little doubt that the specimen taken in Martinique had flown the Atlantic. Its exhaustion followed by its rapid death and extreme degree of emaciation support our belief.

An enquiry addressed to the Weather Bureau of the United States Department of Commerce failed, however, to reveal the existence of an easterly storm or strong winds that could have carried or assisted the bird across the Atlantic. In fact, the Weather Bureau reports that the winds were adverse, at least in the North Atlantic, between 6 and 9 December 1959, stating ". . . that winds were strong and blowing from west to east north of 35 degrees . . . [and] more easterly . . . [but] not very strong . . . southward between 25 degrees and 15 degrees." Martinique lies slightly south of 15 degrees. Nevertheless, it is still possible that the bird may have been deflected to the West Indies by the North East

Trades while migrating to West Africa. We may recall that Eisenmann (1960, *Brit. Birds*, vol. 53, pp. 136–140) mentions a number of species of Palearctic migrants that have been carried to Barbados, the easternmost of the Lesser Antilles lying a little north of 13 degrees. Only one of the birds mentioned by Eisenmann "was attributed by the collector to a specific hurricane."

The Kestrel has, however, crossed the North Atlantic on several occasions. One bird each has been collected in Iceland, Greenland, Massachusetts, and at least four in the Azores. The bird from Iceland was taken on 21 October 1903, the one in Massachusetts mentioned above on 29 September 1887, and one from the Azores on 7 December 1927, a date only two days earlier in December than the bird from Martinique. The dates at which the others were taken are not reported.

A word concerning the normal distribution of *Falco tinnunculus* is in order. This falcon is very widely distributed in Eurasia and Africa, including the islands of Madeira, Canaries, and Cape Verdes. It is chiefly sedentary except in northern Eurasia, the birds from this region wintering south to the Gulf of Guinea, northern Congo, Nyasaland, Arabia, and in India east to southern China. It has also wandered farther south in Asia, to Malaya and Borneo.

We thank Dr. E. R. Blake for lending us the specimen from Massachusetts, Mr. E. Eisenmann for his comments, and the Weather Bureau for its cooperation. —Pere R. Pinchon, *Collège Séminaire, Fort de France, Martinique, French West Indies*, and Charles Vaurie, *American Museum of Natural History, Central Park West at 79th Street, New York 24, New York.*

**Three Further Records of Parasitic Egg Laying by Ducks.**—Weller (1959, Ecol. Mono., 29: 333–365) recently summarized reports of parasitic egg laying among North American waterfowl. After the Redhead *(Aythya americana)*, the Ruddy Duck *(Oxyura jamaicensis)* seems most commonly to manifest this type of behavior. Since Weller's list of species known to have been parasitized by the ruddy did not include the Lesser Scaup *(Aythya affinis)*, the following two records are herewith submitted. On 11 June 1957, a Lesser Scaup nest containing 16 eggs (13 scaup and 3 ruddy) was found beside a Ducks Unlimited Impoundment near Gem, Alberta. Another scaup egg was lying just outside the deserted nest, which was about 10 feet from water and well concealed. A second Lesser Scaup nest containing Ruddy Duck eggs was located 15 June, approximately 600 yards from the first and on the opposite side of the same impoundment. This nest was situated on a small island; it was four feet from water and once again in good cover. There were 10 scaup and 2 ruddy eggs, all of which hatched 11 July.

An apparent case of a Lesser Scaup parasitizing a Ruddy Duck was encountered 27 June, when a nest of 6 ruddy eggs and 1 scaup egg was found. The nest was on firm ground at the very edge of the above-mentioned impoundment. All of the Ruddy Duck eggs subsequently hatched, but the single scaup egg did not.—Lloyd B. Keith, *Department of Forestry and Wildlife Management, University of Wisconsin, Madison, Wisconsin.*

**Night Migration at 4,200 Meters in Venezuela.**—In the Andes, near the city of Mérida, there is a perpetually snow-capped peak, the Pico Bolívar, 5,005 meters elevation, the highest in Venezuela. An overhead cable railway, recently built, reaches the base of the peak at an altitude of 4,700 meters. At 4,200 meters (over 13,000 feet) elevation, there is a station, which is lighted at night. On the morning

of 31 October 1959, my collector, Urbano, arrived at this station and received from the employees of the *teleférico* two Yellow-billed Cuckoos *(Coccyzus americanus)* and a Connecticut Warbler *(Oporornis agilis)*, which had been found dead under the cables or supporting towers.

These birds must have been attracted to the lights and hit the structures, thus meeting their deaths. There is nothing unusual about migrating birds flying into illuminated structures at night, but 4,200 meters seems high, particularly for such a small bird as the Connecticut Warbler. Moreover, there appear to be relatively few records of this species taken on migration south of the United States. My collector reported that the three birds were excessively fat; probably they were on their way far to the south of this locality.—WILLIAM H. PHELPS, *Apartado 2009, Caracas, Venezuela.*

**Natural Longevity Record for a Bobwhite.**—On 4 February 1954, an adult, male bobwhite *(Colinus virginianus)* was banded on the Ashland Wildlife Research Area in Boone County, central Missouri. The bird was shot by a hunter on 29 November 1958. A minimum estimate would place this bird in the 1952 year-class, which indicates that the bird was at least in its seventh year when shot, or about six years and five months old. In a previous estimate of minimum natural longevity, Marsden and Baskett (1958, Jour. Wildl. Mgmt., *22*: 414–419) reported that one male of 1,156 bobwhites banded at Ashland survived to its fifth year (in a population with an average annual mortality rate of 82 per cent). The longest life span for a female recorded in this study was two years and six months. This bird was banded as a young-of-the-year on 4 December 1951 and recovered by hunting on 8 December 1953.—HALSEY M. MARSDEN, *Department of Zoology, University of Missouri, Columbia, Missouri.*

**Additions to the Guatemalan Bird List.**—While conducting a field study in eastern Guatemala from 7 July 1958 to 3 April 1959, we were able to collect specimens of six species previously not reported from Guatemala. The record of one of these, Cattle Egret, *Bubulcus ibis*, has already been published (Auk, 77:218). The others are listed below. We also include a record of the very rare Belted Flycatcher, an endemic species in the Chiapas-Guatemalan highlands.

Great Potoo *(Nyctibius grandis)*. Five miles southwest of Panzós, Department of Alta Vera Paz, elevation 200 feet. Recorded only in humid cultivated areas at night. Hugh C. Land collected an adult female (ovary not enlarged) from a dead tree in a field of corn stubble on the night of 20 January 1959. The specimen is larger (wing 404 mm., tail 283) than any specimen of *N. grandis* available for measurement in the museums of this country. This is the first record of the species north of central Panama (Eisenmann, Trans. Linn. Soc., N. Y. 7: 43).

Olivaceous Piculet *(Picumnus olivaceus)*. Five miles southwest of Panzós and at Zarco, both in the Polochic Valley, Alta Vera Paz, elevation 100 to 200 feet. Fairly common; found in moist woodland. On 8 February 1959, a female was flushed from a newly excavated hole near the top of a fence post. Males taken late in the same month had enlarged testes. Our specimens represent the Honduran race *P. o. dimotus* (Bangs) in having scarlet crown spots in the male and a dark back. Six males and five females were collected; one was taken by Richard R. Graber, who joined us in March, and another, collected by a Guatemalan, was prepared by Mrs. Hugh C. Land.

Gray-headed Manakin *(Piprites griseiceps)*. Five miles southwest of Isabal, Alta Vera Paz, elevation 1,100 feet. A male taken by Hugh C. Land in dense rain forest on 2 January 1959 is the first record north of Nicaragua. This individual was part of a flock of small forest birds, mostly *Microrhopias quixensis*.

Belted Flycatcher *(Xenotriccus callizonus)*. Five miles northwest of Purulhá, Baja Vera Paz, elevation 5,100 feet. Larry L. Wolf took a female of this rare species in heavy brush 11 January 1959. The specimen has a darker crown than the type (which is possibly a subadult) in the American Museum of Natural History.

Brown-capped Vireo *(Vireo leucophrys)*. Seven miles northwest of Usumatlán, Department of Zacapa, elevation 6,300 feet, this location is on the south slope of the Sierra de las Minas. Larry L. Wolf collected a female on 18 December 1958 from a mixed flock of warblers moving through open woods. The specimen closely resembles the type of the Chiapas subspecies, *V. l. strenuus* Nelson, to which we are assigning it.

Prothonotary Warbler *(Protonotaria citrea)*. Five miles southwest of Panzós, Alta Vera Paz, elevation 200 feet. Two specimens of this migrant species were taken together by Hugh C. Land in a swampy woodland on 17 October 1958.—Hugh C. Land, *Biology Department, Concord College, Athens, West Virginia, and* Larry L. Wolf, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

**A Subspecies of *Torreornis inexpectata* from Cuba.**—During the summer of 1959, the junior author accompanied Dr. Albert Schwartz and Mr. Ronald Klinikowski on a collecting trip in Cuba. Dr. Schwartz is making a study of the herpetology of Cuba and the Isle of Pines, with the aid of a National Science Foundation grant.

In addition to Dr. Schwartz's herpetological specimens, a series of Cuban birds was collected for the Reading Public Museum and Art Gallery. While the group was collecting along the south coast of Oriente Provence, on 20 August 1959, Mr. Klinikowski collected two specimens of a bird that has proved to be a new and well-markèd subspecies of *Torreornis inexpectata* Barbour and Peters, the Zapata Finch (called Zapata Sparrow by Bond in his forthcoming *Birds of the West Indies*). This bird may be known as:

***Torreornis inexpectata sigmani*** new subspecies.

*Diagnosis.* Similar in general characters to *Torreornis i. inexpectata*, but slightly smaller especially the bill length, rufous on crown less intense, very little grayish olive on chest and flanks, breast and belly paler lemon yellow, and dorsal streaking indistinct. All known specimens of *sigmani* are considerably paler than any examined adult plumages of *inexpectata*.

*Description.* Crown with two broad stripes of pale Dresden Brown (captalized color terms *ex* Ridgway's nomenclature of colors)—bright Cinnamon Brown in the nominate race—each feather with a dusky shaft streak of Fuscous, and the stripes broadening over most of the crown and occiput; the median and lateral portions of the crown and occiput Smoke Gray (Neutral Gray in *inexpectata*), the median area and the two lateral ones becoming narrow and whitish on the forehead; auriculars, cheeks, and sides of neck and throat Smoke Gray (as opposed to Neutral Gray in the typical form); back, upper wing coverts, rump, and upper tail coverts Grayish Olive (Buffy Olive in the Zapata race) and with the dusky shaft streaks much reduced and paler, less noticeable; remiges and rectrices Buffy Brown (dark Olive Brown in nominate *inexpectata*); chin and throat white with a blackish stripe on

either side of throat as in the typical form; abdomen, thighs, and under tail coverts Primrose Yellow (Citron Yellow in the Zapata bird); sides and flanks very pale and grayish Light Yellowish Olive (dusky Yellowish Olive in the nominate race).

*Measurements.* Adult male (one specimen): wing 64 mm., tail 73, culmen 15, tarsus 21, testes 7 x 6; adult female (one specimen): wing 62, tail 74, culmen 14, tarsus 20.4.

Barbour and Peters (1927, Proc. N. Engl. Zool. Club, 9: 97) give measurements of the nominate race (type series in Museum of Comparative Zoology) as follows: male—wing 66, 67 mm., tail 73, 75, culmen 17, 17.5, tarsus 22, 22.5; female—wing 64, tail 70, culmen 17.5, tarsus 22.5.

Measurements, made by the authors, of *Torreornis i. inexpectata* skins in the United States National Museum (2) and the Academy of Natural Sciences of Philadelphia (3) are as follows: male—wing 65, 67 mm., tail 71.5, 73, culmen 15, 16, tarsus 21, 22; female—wing 65, 66, tail 68, 70.5, culmen 15, 17, tarsus 20, 22; sex unknown (male ?)—wing 67, tail 75, culmen 16, tarsus 23.

*Type.* Adult male (slightly worn but not faded), No. 20394, Reading Public Museum and Art Gallery; 2.3 miles west of Baitiquiri, Oriente, Cuba; 20 August 1959; collected by Ronald Klinikowski, original No. 92.

*Type locality.* Two and three-tenths miles west of the village of Baitiquiri, on the road that extends from the city of Guantanamo to the north coast city of Baracoa. This road follows the Caribbean coast of Cuba eastward, and the type locality is approximately 25 miles east of Guantanamo at a point where the road turns inland to pass through Baitiquiri.

Both specimens of *sigmani* were collected in the middle of the afternoon from the same dead tree. Mr. Klinikowski estimates that the birds were between 5 and 6 meters from the ground. The tree is situated at the base of a cliff approximately 150 meters from the ocean. The terrain between the cliff and the sea is typical of the southern Oriente coast, consisting of sand and limestone, and characterized by xerophytic plant life.

*Distribution.* Known only from the type locality.

*Subspecific name.* This new subspecies honors the late Arthur Tucker Sigman of Elverson, Pennsylvania; this kindly gentleman was an inspirational teacher, conservationist, and amateur ornithologist.

*Remarks.* The genus *Torreornis* remained undiscovered until 1927, when Fermin Z. Cervera collected the first specimen from Santo Tomás, Peninsula de Zapata, Cuba (Barbour and Peters, *op. cit.*, 95–97). *Torreornis i. inexpectata* is restricted to the Zapata Swamp (Bond, 1956, *Check-list of Birds of the West Indies*, p. 185), approximately 450 miles west of the type locality of *sigmani*.

This new desert race apparently consists of a relatively small population, since it remained undiscovered until 1959. Dr. Friedmann (in review of manuscript) makes the following comment: "It is more surprising that this race remained undiscovered until 1959 than that the Zapata form was not found until 1927, as the swampy habitat of the latter is difficult of access. When one recalls the surprise occasioned by the discovery of this and two other birds in the Zapata Swamp in 1927, the present discovery seems all the more unexpected, particularly since the region is fairly close to where (Charles T.) Ramsden did much of his collecting over many years."

This subspecies was previously noted by Spence ("Miscellaneous Notes of the Baird Ornithological Club," 2 November 1959); however, since the paper is mimeographed, it does not constitute a valid description.

ACKNOWLEDGMENT

We are grateful to Dr. Herbert Friedmann for his valuable suggestions concerning this paper, especially for his contribution to the section on description. We also wish to thank Mr. James Bond and Dr. Herbert Deignan for allowing us to examine all the specimens of *Torreornis inexpectata* in the collections of the Academy of Natural Sciences of Philadelphia, and the United States National Museum. In addition, we thank Mr. Samuel C. Gundy for his encouragement in the preparation of this paper.

*Specimens of Torreornis i. inexpectata examined.* USNM 307991, 26 April 1927, Santo Tomás, adult male; ANSP 108217, 18 May 1933, Santo Tomás, adult male; ANSP 85819, 20 February 1927, Santo Tomás, adult female; ANSP 111907, 5 January 1931, Santo Tomás, adult female; USNM 454883, no date, Santo Tomás, sex (?).

*Specimens of Torreornis inexpectata sigmani examined.* RPM 20394, 20 August 1959, Baitiquiri, adult male; Klinikowski private coll., on deposit in USNM, 20 August 1959, Baitiquiri, adult female.—MATTHEW J. SPENCE and BARTON L. SMITH, *Reading Public Museum and Art Gallery, Reading, Pennsylvania.*

**Unusual Feeding Habit of Boat-tailed Grackle.**—Much has been recorded about the feeding of the Boat-tailed Grackle *(Cassadix mexicanus)* on fresh-water snails and fresh-water mussels.

Howell's *Florida Bird Life* describes these birds as "sometimes completely immersing their heads in their search for food."

On 27 December 1959 in the Vero marsh, I noticed a male grackle in the top of a small cypress tree feeding on a snail. I stopped to watch, and in a few minutes a second male boat-tail flew nearly up to the boat, hovered for a few seconds about two meters above the water, then dived head first, like a kingfisher, into the clear water, which was about 40 cm. deep. It remained under water for a brief moment, with only the very tip of its tail showing. Then it came to the surface, shook itself to dry, and flew to a nearby tuft of cane and began to eat the meaty contents of a snail.—CHARLES E. CARTER, *1339 30th Street, Orlando, Florida.*

**First Blue Grosbeak Collected in Ontario.**—On Monday, 23 May 1960 at Long Point, Norfolk County, Ontario (42° 34′, 80° 15′) a Blue Grosbeak *(Guiraca caerulea)* was captured in a Heligoland trap. The bird was an immature male and is now No. 90869 in the collection of the Royal Ontario Museum. It is the first specimen taken in Ontario.

Since 1918, when a male was seen in August in Toronto by L. L. Snyder, there have been a number of reports of this species from southern Ontario and one report from western Ontario. A number of these have been published, either in the *Canadian Field-Naturalist*, or *Audubon Field Notes*. Some are probably valid records. The recent *A.O.U. Check-list of North America birds* (fifth edition, 1957) describes the Blue Grosbeak as casual in Southern Ontario but Snyder (1950, *A Classification of Ontario Birds*, Misc. Pub. No. 3, R.O.M.Z.) makes no mention of this species even hypothetically.—JAMES WOODFORD and D. H. BALDWIN, *Royal Ontario Museum, Toronto 5, Ontario.*

**Duetting by Paired Brown-headed Cowbirds.**—In 1957 I became aware that duetting was being done by apparent pairs among the color-banded Brown-headed Cowbirds *(Molothrus ater)* coming to my window feeding shelf, and in each year

since then I have confirmed the observation. I have also once noticed duetting by two birds on an electric wire. Through 1960 a total of 11 pairs have duetted; all of the birds were color-banded ones except the male of one pair and the female of another. A male and female were judged to be paired when they associated regularly, often being found at the feeder and elsewhere unaccompanied by others, and often coming to the feeder together and leaving together.

Typically, in the duetting, the female gives her rattly utterance during the *glug-glug-gleeee* song that a male gives with his bowing display. Sometimes the rattle begins with the male's second *glug*, but generally it accompanies the *gleeee* note, and when—as often happens—the male omits the *gleeee*, the combined utterances of the duetting birds sound like *glug-glug-rattle* given without a break. The female will duet not only when the male is directing his song and display to her, but when he is directing them at another male, at his reflection in the window pane, at some other species of bird, or at nothing.

Exceptionally, I have seen duetting by birds not regular associates. Two females besides his mate duetted with one male. One female duetted with three extra males, at times when all of the three were travelling regularly with other females, and once a female duetted when a male who was such an atypical duetting partner gave a *peee* note. All of these birds were color-banded ones. Possibly instances like these were the result of especially high sexual tension, for I have sometimes seen females give their rattle in response to silent acts of their mates; for instance, one did so when her mate ran silently toward her, and again when in a bow with wings spread he ran silently between her and another male.

Occasionally, also, I have seen a female begin a rattle and her mate then join in with a song and display; I have not been able to decide whether to regard this as an inversion of the usual duet or as a coincidence.

The frequency of the duetting has varied considerably. I saw one pair do so on 23 days in the period 21 March–20 May; another pair on 17 days 26 May–11 July; another pair on 5 days 18 May–10 July. Twice I have had pairs that I never saw duet. The rate has also varied; during some visits to the feeder a pair has given no duets; on other visits there have been as many as five in two minutes and eight in three minutes.

My dates for the duetting have been 21 March to 11 July 1957; 16 April to 19 July 1958; 19 April to 14 July 1959; 9 April to 16 July 1960. Extreme known egg dates for Maryland are 24 April and 28 July, with the nesting peak "early May to early July" (Stewart and Robbins, *Birds of Maryland and the District of Columbia*, North American Fauna No. 62: 329, 1958).—Hervey Brackbill, *2620 Poplar Drive, Baltimore 7, Maryland.*

**Shadow Boxing by Brown-headed Cowbirds.**—In four of the five years that I have operated a window-sill feeding shelf at my present location, one or more of the color-banded male Brown-headed Cowbirds *(Molothrus ater)* coming to it have given the bowing display to their reflection in the pane, and the most persistent displayer also repeatedly attacked it. Less commonly, the vertical bill-pointing display has been given to the reflection. On a single occasion a female has been seen to display and attack. Almost all of the males have been paired birds, judging by the regularity with which each associated with a particular color-banded female.

In 1956 one male (out of eight patronizing the feeder) gave bowing displays to the pane, with the *glug-glug-gleeee* song, from 11 May to 19 July. In addition, from 12 to 30 May, and again 22 to 28 June, he sometimes pecked the pane or flew

against it. In 1957 this male returned and displayed to the pane from 21 March to 24 May, the date on which he was last seen. He pecked the pane from 29 March to 18 May.

In 1957 three other color-banded males displayed to the pane occasionally or frequently. In 1958 four, and in 1959 two, occasionally did so. In 1960 none of five was ever seen to do so. These included one that had sometimes displayed in 1958 and 1959; in those years he was paired; in 1960 he apparently was not.

The female's shadow boxing, on 8 June 1957, consisted of a very slight bow with a lifting of the plumage of the upper back, and then a dash against the pane. The bird was unbanded.—HERVEY BRACKBILL, *2620 Poplar Drive, Baltimore 7, Maryland.*

**The Caracara Nesting in Arizona.**—On 20 March 1960 my brother John and I located a pair of Caracaras *(Caracara cheriway)* constructing a nest, about three miles north of Ali Chuk, Papago Indian Reservation, Pima County. The nest was situated 15 feet up a sahuaro cactus *(Cereus giganteus)* in a crotch formed where several "arms" joined the main stem or trunk.

On the same day a Caracara was seen flying low over Pacinimo (Pisinimo) about 20 miles northeast of Ali Chuk. This individual very likely represented another breeding pair.

Returning to the Ali Chuk nest on 24 May, we found that it contained three nestlings about a month old. The nestlings were photographed at this time.

On 9 June 1960 I located another active Caracara nest in a site similar to the above described nest, about six miles north of Quijotoa (Covered Wells). This pair was some 30 miles northeast of the Ali Chuk nest. The two young were out of the nest and barely able to fly, but were still in the immediate vicinity of the nest.

These appear to be the only reported breeding records of this species in Arizona since Herbert Brown's observations in 1889 as noted by Bendire (1892, *Life Hist. North Amer. Birds,* U.S. Natl. Mus., Spec Bull No. 1, 317).—SEYMOUR H. LEVY, *Route 9, Box 960, Tucson, Arizona.*

**Albinism in the Small White-Cheeked Geese.**—On 28 October 1959 a rare example of incomplete albinism, as defined by Nero (1954) and Pettingill (1956), in *Branta canadensis* ssp. was captured at the Salt Plains National Wildlife Refuge, Alfalfa County, Jet, Oklahoma. An immature female and tentatively identified as *B. c. hutchinsii* (the term small white-cheeked geese includes the races *leucopareia, parvipes, hutchinsii,* and possibly others that are as yet unrecognized), it displayed the pink irides, yellowish to flesh-colored bill, tarsi, and feet of a typical albino. However, all areas of the plumage that would normally have been black—the head and neck, rectrices and primaries—were suffused with a creamy to light tan color. The remainder of the plumage was white. The white cheek patch of the head was discernible against the tannish background. During succeeding months it was observed that the new feathers of the first adult plumage were gray rather than creamy-tan or white. The feathers of the head and neck molted a rather dark gray; those of the body, a very pale gray.

Other examples of albinism in small Canada geese were observed in the 1958–1959 waterfowl season. At the Tishomingo National Wildlife Refuge, Johnston County, Tishomingo, Oklahoma, during a period of approximately two weeks from 12 to 28 December 1958 an example of partial albinism in a medium-sized goose, perhaps *B. c. parvipes,* was regularly observed. Close examination showed that the gray appearance of the head and neck was the result of a rather uniform speckling of

black and white feathers. On 9 March 1959 at the Hagerman National Wildlife Refuge, Grayson County, Denison, Texas, an example of imperfect albinism or dilution in a medium-sized goose, perhaps *B. c. parvipes*, was observed. The head, neck, primaries, and rectrices of this goose appeared to be normal black, but the body plumage was a very light gray.

In discussion of his own observations in Illinois, in addition to a summarization of observations of albinistic geese by several other authors, Hanson (1949) lists no example of incomplete albinism in the Canada geese. However, the description offered by Murray (1933) would appear to be a case of incomplete albinism in *B. c. canadensis* rather than partial albinism (Hanson prefers "white spotting) as it is listed.

Other observed plumage variations involving white feathering, but which may not necessarily be an expression of albinism in any degree, include the white collar at the base of the black stocking of the neck, white forehead patch, and white feathers in the underwing coverts, all discussed by Elder (1946) and Hanson (1949). The relative occurrence of the last three phenomena in small Canada geese handled in Oklahoma, Texas, and Colorado differs considerably from the findings reported by Elder (1946) and is offered in Table 1 for comparison.

TABLE 1

Relative Occurrence of White Feather-Patterns in Small White-Cheeked Geese of the South-Central Flyway

| | *Adult* | | *Immature* | |
|---|---|---|---|---|
| | *Male* | *Female* | *Male* | *Female* |
| Number | 85 | 64 | 72 | 46 |
| Per cent with white collar | 54 | 39 | 25 | 26 |
| White feathers in forehead | 17 | 9 | 17 | 20 |
| White feathers in underwing coverts | About 5 per cent of adult sample | | | |

Pertinent information concerning the incomplete albino at the time of capture at Salt Plains, 28 October 1959, follows: Immature female—Band No. 597-66491; tarsus—61.6; middle toe—54.3; culmen—33.5; maxilla length (tomium)—35.8; maxilla height (at base)—19.3; weight—3 lb. 5 oz.; condition—fair; wing chord—primaries of both wings damaged and frayed, no measurement taken.

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—Richard E. Marquardt, *Research Fellow, Oklahoma Cooperative Wildlife Research Unit, Stillwater, Oklahoma State University, Oklahoma Department of Wildlife Conservation, U. S. Fish and Wildlife Service, and Wildlife Management Institute cooperating. Zoology Department Contribution No. 318.*

## REVIEWS

**The Palatine Process of the Premaxilla in the Passeres. A Study of the Variation, Function, Evolution, and Taxonomic Value of a Single Character throughout an Avian Order.**—Walter J. Bock. 1960. Bull. Mus. Comp. Zool., Vol. 122, No. 8, pp. 361–488, 29 figs.—In view of the considerable recent controversy over the relationships and arrangement of the passerine families, this study of a presumably useful taxonomic character—the palatine process—should be examined carefully. In studying the variation, function, and evolution of this structure, Bock concludes that it has "little value in showing relationships between families of passerine birds," and he is particularly critical of Tordoff's conclusions, which were based on the palatine process. There is much of value in this paper, but there are also some weaknesses and inaccuracies in the premises on which the conclusions are based.

Bock synonymizes the terms "palato-maxillary" of Parker, Tordoff, and others, and "secondary palatine process" of Shufeldt, with "palatine process of the premaxilla" (Parker), at least as applied to passerines. Embryological evidence, presented by Parker, Jollie, and Bock, although indeed scanty, supports this view. He suggests that the palatine process is present in all immature passerine birds, and that all of its manifestations (*i.e.*, free process, unfused process, bony splint, fused process, and lateral flange) in adult passerines represent homologous structures.

In an effort to determine the function of the palatine process in each of its forms, Bock studied the jaw musculature of various passerines. The discussion centers on the pterygoideus muscle, part of which originates from the palatine process in those species having a free process. Each of the four parts of the pterygoideus is described, and it is concluded that in general the lateral portions of the muscle serve mainly to raise the lower jaw and the medial portions to retract the palate, thereby lowering the upper jaw. Bock claims that "in the seed-eaters, the medial parts of this muscle are relatively small while the lateral parts are relatively large. In the insect-eaters, the medial parts are relatively large, although they are still smaller in mass than the lateral parts of the M. pterygoideus. . . ." He postulates that the attachment of a part of the pterygoideus to the free palatine process (as seen in Indigo Bunting, Cardinal, etc.) may be an adaptation for rapid raising of the lower jaw, an advantage in catching insects, but he found little or no connection between the palatine process in its other forms, and the pterygoideus.

Several criticisms of this section should be made: first, there is no mention of which species, or how many of each, Bock dissected; second, there is no explanation of his method for determining relative size or mass of muscles—a difficult task in small birds that vary in size; third, the function ascribed to the pterygoideus dorsalis medialis, that is, retraction of the palate, applies only to fibers attaching on the basitemporal plate—the bulk of this muscle affects primarily the lower jaw; fourth, functions are given individual muscles or parts of muscles without regard to synergistic actions of other muscles—a serious omission when dealing with jaw muscles.

According to Bock, the heavy-billed cardinalines and the heavy-billed carduelines exhibit basically different methods of seed cracking. The former use a "nut-cracker" technique, in which both jaws are freely movable. Seeds are broken by depression of the upper jaw and raising of the lower jaw; thus well-developed adductor and retractor muscles are required. The shocks associated with seed cracking "are borne by the jaws which form a system partially isolated from the brain-

case." By contrast, the carduelines use the "vise" method. "In the specialized carduelines, the upper jaw has lost its mobility; it is a nearly stationary block against which the mandible presses. Heavy bosses of bone (the lateral flanges) and the rhamphotheca distribute the shocks associated with the cracking of the seed evenly to all parts of the braincase. Only the adductor muscles are well developed. . . ." Bock states that the distinction between these feeding methods becomes "fuzzy" in the less-specialized members of both groups, but he assumes (while acknowledging the lack of evidence for it) that species in other groups with the lateral flange (modified palatine process) use the vise method (that is, estrildids, advanced ploceids, *Oryzoborus*, and *Psittirostra*).

There are several difficulties with the proposed "vise" method. With the exception of the hawfinch *(Coccothraustes)*, no passerine bird has been shown to have a virtually immovable upper jaw. The upper jaw of the Evening Grosbeak *(Hesperiphona)* is fully as movable as that of a Cardinal *(Richmondena)*; yet these are the two species used to exemplify the different feeding methods. Furthermore, it is not clear how the lateral flange could evenly distribute a shock wave, originating in the jaws, to the skull.

Bock presents a useful synopsis of passerine families, giving the form of the palatine process, and age and individual variation wherever possible, based on "some 3300 specimens representing 500 genera of all but a few passerine families. . . ." Semidiagrammatic drawings of 45 genera representing 25 families and subfamilies are included. These are following by a discussion of various evolutionary principles and their application to the evolution of the palatine process. Based on his functional analyses, Bock assumes that selective forces "exert a fairly tight control on the palatine process." He believes that "the several controlling selection forces have arisen repeatedly and have reversed their direction numerous times during the evolution of the perching birds . . ." and that the palatine process, therefore, "has *little or no* value in showing relationships between families of passerine birds or in placing problem genera into the correct family." Consequently, he feels that Tordoff's conclusions should be dismissed pending further evidence. Bock discusses the evolution of the New World nine-primaried oscines at some length without positive results. He argues, finally, for the importance of comprehensive single-character studies such as the one under review, not because taxonomic conclusions can be drawn from any one study, but because "with several dozen such works, there would be a good chance of unraveling the entire evolutionary history of the recent Passeres." This view seems overly optimistic, especially in view of the inherent difficulties of the single character survey. Bock has demonstrated that the analysis of function of a single character soon involves one in a whole complex of characters. The subtleties of function require painstaking analysis of the entire character complex, an almost impossible task when dealing with the entire order Passeriformes. Anything less leads to errors and uncertainties such as are found in this functional analysis, and which, as Bock himself points out, correspondingly weaken the evolutionary and taxonomic conclusions. The immediate contribution of the single character study is likely to be the descriptive survey rather than the interpretation.

Several errors, which impair understanding of the text, should be mentioned: p. 393, line 31, for "mandible" read "maxilla"; p. 406, line 14, for "its" read "the"; p. 412, line 40, for "and" read "are"; p. 416, line 12, for "16B" read "16A."—Richard L. Zusi.

**Atlas der Verbreitung palaearktischer Vögel.**—Erwin Stresemann and L. A. Portenko. 1960. First installment (20 breeding ranges and 4 migration maps). Akademie Verlag, Berlin—We know the exact distribution of birds far better than that of any other kind of animals except a few of economic importance. Yet this information is exceedingly scattered, and very few species have ever been mapped with precision. To remedy this deficiency is the avowed objective of the new atlas, a product of harmonious international cooperation. The first installment of this work contains 20 maps, and nine further installments, each with 20 maps, will complete it. There are several notable innovations in this atlas. Most maps are about 8 x 11 inches, a different base map is being used in each case, to utilize a maximal amount of space for the range outline. The outermost range border is indicated by 30-80 numbered points, the number referring to literature citations in the text. Isolated breeding stations outside the continuous range are indicated by individual points. Dotted lines indicate uncertain range borders. A text with each map gives information on relationship of each species, ecology, geographic variation, and migration.

This atlas will be of the greatest value to ornithologists and indeed to all biogeographers. It will no doubt set a standard that other designers of distribution maps will want to emulate.—Ernst Mayr.

**Atlas of European Birds.**—K. H. Voous. 1960. Thomas Nelson and Sons, 19 East 47 St., New York. 284 pp., 419 maps, 355 photographs. $15.—This attractive and useful volume is an English-language edition of the *Atlas van de Europese Vogels* (Elsevier, Amsterdam, 1960). For each of 419 European species there is a brief text (faunal type, distribution, habitat, food, nest, movement) and a map showing the entire known breeding range of the species. For most species there is also a photograph. As the author points out, the maps lack precision because of the scale used. The primary function of them is to give some zoogeographic insight into the distribution of the species concerned. From this aspect there are actually relatively few criticisms, although the strange arrangement of North American rivers does not instill confidence in their accuracy. The systematics are relatively conservative. The following pairs are treated as conspecific: *Tringa hypoleucos* and *Actitis ( = Tringa) macularia, Lanius excubitor* and *Lanius ludovicianus, Regulus ignicapillus* and *Regulus satrapa,* and, *Carduelis hornemanni* and *Carduelis flammea.* The *Atlas* contains much of interest to the American ornithologist, not only because of the Holarctic distribution of many American species, but also because the author invariably notes the Nearctic counterparts or replacements of European Palaearctic species when such exist. The arrangement and organization of the book are optimal. The quality of the photographs is good and contributes much to the attractiveness of the volume.—D. S. Farner.

**The Trumpeter Swan—Its History, Habits, and Population in the United States.**—Winston E. Banko. 1960. U.S. Government Printing Office, Washington 25, D.C. North American Fauna No. 63, 214 pp. $1.00.—A few decades ago there was genuine and justifiable concern that the Trumpeter Swan could soon become extinct. The decline in the population of this once fairly widespread species has ceased. Indeed, there has been some recovery to a continental population level of about 1,500 individuals. Of these, about 600 occur in the tri-state area of Montana, Idaho, and Wyoming, including Yellowstone National Park and Red Rocks Lake Refuge. This treatise is concerned basically with the population of this tri-state

area, with the bulk of the information from the investigations and observations at the Red Rocks Lake Refuge. It is inevitable that this should be the case, since the Refuge has been of such fundamental importance in the recovery and stabilization of the species in this area. The author is to be commended for a thorough inventory and analysis of the information concerning this species with emphasis on the population in the United States. There are extensive sections on distribution, habitat, life cycle, population, and management. But this is more than a monographic treatment of an interesting species. It is tangible evidence that there is a growing appreciation of our biotic national heritage, an appreciation that makes it possible to rescue and preserve an endangered species.—D. S. FARNER.

**Birds of Campbell Island.**—Kaj Westerskov. 1960. Wildlife Publication No. 61, New Zealand Department of Internal Affairs, Wellington. 83 pp., 21 photographs, 4 figs.—Much of this interesting little book is based on the author's observations and collections while a member of the Denver Museum of Natural History expedition, which was on Campbell Island from 7 January to 19 February 1958. In addition to this, however, he has carefully reviewed and included the important observations of 20 earlier expeditions and visits to the island, beginning with the discovery by Frederick Hazelburgh in 1810. The annotated list contains 57 species. The author estimates that there were 2,300 pairs of the Southern Royal Albatross, *Diomedea epomophora epomophora*, during 1957–1958, suggesting that the present breeding population is about 4,600 pairs, bearing in mind that the birds breed every other year. The author's investigations of this species are being reserved for a separate publication.—D. S. FARNER.

**XII International Ornithological Congress, Helsinki 5.–12. VI. 1958. Proceedings.**—Edited by G. Bergman, K. O. Donner, and L. von Hartman. 1960. Vol. 1, pp. 1–436; Vol. 2, pp. 437–822.—In addition to the reports, list of members, list of delegates, and the presidential address by Professor J. Berlioz (pp. 1–49), the *Proceedings* contains 97 papers presented at the general sessions and at the symposia on *Adaptive Evolution in Birds*, *Avian Classification*, and *Nocturnal Migration*. This collection of papers demonstrates not only the increasing rate of ornithological research but also a greater diversity and an enhanced quality. The papers were contributed from 20 different countries.

Dr. Lars von Hartman, General Secretary of the Congress, has informed me that, at the time of mailing of the *Proceedings*, an explosion occurred at the printing plant and that most of the copies were destroyed by fire. A reprinting will be effected; however, there will be a delay of several months before many subscribers will receive their copies.—D. S. FARNER.

**The Second Pan-Soviet Ornithological Congress, 18–25 August 1959. Summaries of Communications. [Vtoraya Vsesoyuznaya Ornitologicheskaya Konferentsiya, 18–25 Avgusta 1959, g.]**—Izdatelstvo Moskovskovo Universiteta, Moscow. 1959.—Part 1, 94 pp; Part 2, 111 pp, Part 3, 128 pp. (No foreign-language summaries.)—This very interesting publication contains summaries of 266 communications. Crudely classified by the reviewer, these are distributed as follows: systematics and evolution, 12; distribution and zoogeography, 80; ecology and natural history, 71; physiology, 7; morphology and anatomy, 17; embryology and development, 8; behavior, 10; reproduction, 8; migration, 24; diseases and parasites, 15; bird protection, 2; miscellaneous, 12. Of interest are summaries (Part 3, pp. 17, 18, 20, 22) of

four papers dealing with Antarctic investigations. Also of very substantial interest is a paper by B. G. Novikov, O. P. Chepinoga, and M. A. Lyubarskaya of Kiev (Part 1, pp. 60–61); this paper reports that it has been possible to modify the molecular weight of the deoxyribonucleic acid of duck Erythrocytes by the injection of preparations of deoxyribonucleic acid from a race in which the molecular weight is characteristically different. This report is of interest because of its possible bearing on the controversial experiments of J. Benoit, P. Leroy, C. Vendrely, and R. Vendrely *(Compt. Rend. Acad. Sci. Paris,* 244: 2320–2321; 245: 448–451), in which it was reported that injection of deoxyribonucleic acid preparations from one race into the ducklings of another race resulted in the development of some characteristics of the donor race and that some of these alterations occurred in the offspring of the treated birds.

Presumably the papers represent the spectrum of ornithological research in the USSR. This spectrum would appear to differ from that of American ornithology primarily in the lesser emphasis on research on behavior and migration. —D. S. FARNER.

**Ecological Studies on Mammals, Birds, Reptiles and Amphibians in the Eastern Belgian Congo.**—Part II (Report No. 1 of the Swedish Congo Expeditions 1951–1952 and 1958–1959). Kai Curry-Lindahl. 1960. *Annales du Musée Royal du Congo Belge,* Tervuren (Belgique), *Série in* 8°, *Sciences Zoologiques,* Volume 87. 170 pp., 39 photographs.—This volume consists largely of notes on 253 non-passerine species obtained by the Lund University Congo Expedition of 1951–1952 and the Swedish Congo Expedition of 1958–1959. The investigations were conducted mostly in the eastern Belgian Congo and in Ruanda-Urundi. The notes are rich in important biological observations on African species. Evidence is cited for an expansion of *Pelecanus rufescens* in Ruanda-Urundi and for increase in numbers of *Ardea cinerea* at some localities in eastern Belgian Congo. Territorial behavior on the wintering grounds was observed in both sexes of *Tringa hypoleucos.* The author cites cases in which it appeared that flocks of *Merops persicus* in migration induced migration in smaller groups of resting *Hirundo rustica.* It was observed that *Apus affinis* and *Apus caffer* may leave their breeding colonies for several days and then suddenly return. Although this superficially resembles similar movements by *Apus apus* during periods of bad weather, there are no data to suggest that a similar relationship exists for these African species. These are only a few of the many interesting contributions to the biology of African birds.—D. S. FARNER.

**The Art and Practice of Hawking.**—E. B. Mitchell. 1959. (Reprint Edition, first published in 1900.) Charles T. Branford Company, Boston. 291 pp. 10 pls. $6.00.—This is essentially a practical handbook concerning the fundamentals of the art of falconry. For the beginner it covers detailed instructions for the capture, care, and training of a hawk or falcon from the time it is secured until it is flown at game. The seasoned falconer will find a most interesting record of hawking as practiced in England prior to the turn of the century, as well as much of value concerning the care and handling of his birds. The first chapter covers the antiquity of this ancient sport, its history and related literature on the subject. The next is a list of the birds of prey most commonly used in Europe and Asia for hawking, with descriptions and characteristics of the various species. There is also a discussion of the difference in character, temper, and disposition between the so-called "long-winged" species *(Falconidae)* and the "short-winged" species *(Accipitridae).* In view

of present-day recognition of a single species of gyrfalcon, it is interesting to note that the author describes four different species: *Falco candicans, Falco islandus, Falco gyrfalco, Falco labradorus.* However, in a footnote he states: "They are indeed little, if anything, more than climatic varieties of the same bird." Several different races of peregrine are also described as separate species. Other chapters include the fittings and appliances that should be used in falconry; methods of capture; care and training; methods of game-hawking for various quarry; recovery of lost hawks; and treatment for maladies and accidents. The chapters concerning Lark-Hawking, and Gull- and Heron-Hawking are little more than stories of the chase. Perhaps they could best be used as propaganda against falconry, but at least they convey a story of this fashionable sport in years gone by. For those interested in falconry, this volume will be a valuable addition to their library.—L. R. WOLFE.

**Våra Fåglar i Norden. Vol. II** (Rev. Ed.)—Kai Curry-Lindahl, Editor. 1960. Bokförlaget Natur och Kultur, Stockholm. 567–1002 pp., *262* black and white photographs, 11 figs., 56 color plates.—Volume II of this extensive treatise of Scandinavian birds includes the galliform (8), gruiform (5), and charadriiform (35) species. For most of the species there is a general account followed by detailed descriptions of plumages (adult and young), voice, general distribution, occurrence in Sweden, habitat, and migration.—D. S. FARNER.

**The Wonders I See.**—Second Edition. John K. Terres. 1960. J. B. Lippincott Company, Philadelphia and New York. 256 pp., with sketches. $5.00—Over 80 selected encounters with squirrels, insects, spiders, birds, and other everyday animals, spanning a year of time, are presented in remarkably intimate detail in this book. The scope of material is based on more than eight years of note taking and ranges from a primitive beach to a Long Island lawn, from a deer floundering through deep New England snow to white ibises flying over Lake Okeechobee in Florida, with emphasis on animals that surround the average person's daily life.

John K. Terres learned to know individual insects and spiders, birds, and generations of squirrels by banding and by marking them with harmless dyes. His fascinating accounts are proof of his belief that the only way really to learn about animals is to study them as individuals, and that the small animals in his backyard—sparrows, woodpeckers, centipedes, and others—lead no less interesting lives than a black bear, an antelope, or an eagle. In the words of John Locke, "He that hawks at larks and sparrows has no less sport than he that flies at nobler game."

To me the most important message of his book relates to the philosophy of observation. Why do some bird lovers see Lincoln and Leconte sparrows that many observers have never recorded? Are these birds actually few in numbers, or do they occur only in very special places at restricted times? How does a naturalist develop a pattern of life for an animal he sees only occasionally or seasonally by merely making a few jottings in his field dairy? These and hundreds of other questions relating to animals and plants are implicitly involved in Terres' philosophical statement in the Introduction: "What I saw today, you may see tomorrow. To see well and to develop the 'seeing eye' one needs to have interest, sympathy, and the understanding heart. To see *correctly*, one needs knowledge, because interpretation is a part of seeing truly." I am reminded of Carlyle who wrote: "With their great eyes men do stare withal, so few can see."—IRVEN O. BUSS.

**Ducks, Geese, and Swans. A Sunset Junior Book.**—Herbert Wong; illustrated by William D. Berry. 1960. J. B. Lippincott Company, East Washington Square, Philadelphia. 63 pp. $2.95.—This carefully conceived little book has been prepared primarily for children of about eight to ten years of age. In addition to general discussions of waterfowl, there are descriptions and illustrations of the common species of ducks, geese, and swans of western North America. Also included are useful brief discussions of migration, bird-banding, dangers to waterfowl, and waterfowl protection. A wide circulation of this book would go far in creating an enhanced appreciation of waterfowl in a new generation.—D. S. FARNER.

**Songs of Fringillidae of Eastern and Central North America. Sounds of Nature. Vol. 6. Finches.**—Recorded by Donald J. Borror and William W. H. Gunn. 12" 33-1/3 rpm. $5.95. Federation of Ontario Naturalists, Edwards Gardens, Don Mills, Ontario, Canada. (In United States: Curtiss and Weir, 54 Priscilla Place, Trumbull, Connecticut.)—This record reproduces the voices of 43 (possibly 44) species of North American finches. The quality is good. As in the earlier warbler record of the same authorship, vocalizations are grouped according to similarity, rather than taxonomic relationship. The jacket supplies a species index and also shows the number of songs (or song sequences) reproduced and the number of individuals of each species involved. For most species at least six songs are given; for the Cardinal, White-throated Sparrow, and Rufous-sided Towhee 15 or more. A three-page, mimeographed leaflet supplies such significant data as the locality and month of each reproduced vocalization, and which were uttered by the same individual, as well as other pertinent facts. All this enhances the scientific usefulness of the record, for it facilitates the study of geographic, seasonal, and individual variation in song and provides a basis for taxonomic comparison. The leaflet adds that a detailed analysis of the songs (illustrated by spectrographs) is being prepared, available on request for 25 cents. Considering the scientific value of records like these, technical (as well as English) names of the species should be included, either on the jacket or the enclosed leaflet. With its supporting data this recording is a real contribution to ornithology and a service to the bird watcher wishing to identify songs or interested in the esthetic aspects of avian voices.—E. EISENMANN.

**A Treasury of New Zealand Bird Song.**—An album of three 45 rpm extended-play disks boxed with a 40-page booklet describing, and portraying in black and white photographs, 30 species, including 11 introduced species. Recording and photography by Kenneth and Jean Bigwood. Text and commentary by Gordon R. Williams. Published by A. H. and A. W. Reed, Wellington. 45 s.—This is an album of exceptional quality, both technically and ornithologically. On the average, a little more than one minute is devoted to each species. This gives an unhurried quality to the presentation. Song description in the booklet is closely tied to the recording and is helpful. Most listeners would be willing to forego the pleasure of listening to House Sparrows and Starlings, but even these are well done.

Mr. Gordon Williams has done a nice job on the text and commentary. The latter, which appears to introduce each species on the disks, has been quoted from outstanding literature and often adds much to the enjoyment and understanding of the recording. To anyone familiar with or interested in New Zealand birds, this collection is recommended.

Technically, the recording is excellent. The signal-to-noise ratio, which is always a serious problem in natural history recording, is well above average in all but a few instances, such as the European Goldfinch. Water noise in the background of the Blue Duck seemed perfectly natural. In the few instances where other birds were heard in the background, they were mentioned in the text. Distortion in the recordings seemed reasonably low, although some was noticeable on high notes with steep wave fronts on the two separate reproducers on which I listened to the disks. This is usual in all bird recordings published today and emphasizes the need for more investigation into the very special problems of recording bird songs.—PETER PAUL KELLOGG.

## RECENT LITERATURE

EDITED BY FRANK McKINNEY

### Anatomy and Embryology

Greenewalt, C. H., W. Brandt, and D. D. Friel. 1960. The iridescent colors of hummingbird feathers. Proc. Amer. Phil. Soc., **104**: 249–253.—Iridescence is caused by interference produced by a thin film. In hummingbirds strong iridescence is caused by the superimposition of about three films. Electron photomicrographs reveal layers of platelets at the surface of the barbules; the platelets consist of a matrix enclosing air bubbles. Iridescent color varies depending on both air content and thickness of platelet. Optics discussed; photographs.—E. E.

Greenewalt, C. H., W. Brandt, and D. D. Friel. 1960. Iridescent colors of hummingbird feathers. Jour. Optical Soc. of Amer., **50**: 1005–1013.

Johnson, D. W. and F. S. L. Williamson. 1960. Heart weights of North American Crows and Ravens. Wilson Bull., **72**: 248–252.—Body and heart weights for three species of *Corvus* are reported. *C. corax*, the largest, had the smallest heart ratios. Males had larger heart ratios than females, and first-year birds had larger ratios than adults.—J. T. T.

Kuroda, N. 1960. On the Meckel's Divertikel [*sic*] of avian intestine. Misc. Reports of the Yamashina's Inst. for Ornith. and Zool., **2** (14): 41–49.—Reviews presence or absence in adults, size, and relative position of Meckel's diverticulum in various orders of birds. Histological studies (with photographs) of this organ in *Aythya fuligula* and *Xenus cinereus*. ". . . this divertikel, though in some cases it shows secondary development, is not considered very significant functionally and adaptively." (In Japanese with English summary.)—K. C. P.

Kuroda, N. 1960. On the pectoral muscles of birds. Misc. Reports of the Yamashina's Inst. for Ornith. and Zool., **2** (14): 50–59.—A review by orders of the relative weight of the pectoral muscle mass to body weight, and of relative weights of muscles within this mass. Relative proportions of *M. pectoralis major* and *M. p. minor* are correlated with mode of flight, the latter being least developed in soaring birds and best developed in wing-diving sea birds (Alcidae). An anterior superficial layer of *M. p. major proprius* in herons is named *M. p. m. antero-superficialis*. (In Japanese, with English summary, tables, and captions to figures.)—K. C. P.

Kuroda, N. 1960. The tibial muscles of the ostrich. Misc. Reports of the Yamashina's Inst. for Ornith. and Zool., **2** (14): 63–66.—Tibial muscles of right leg of an ostrich dissected, figured (photographs and drawings), and compared with those of "typical" birds. Three of the 13 tibial muscles of "typical" birds were not found in the ostrich. (In Japanese, with English summary and captions to figures.)—K. C. P.

Plack, P. A. 1960. Vitamin $A_1$ aldehyde in hen's eggs. Nature, **186**: 234–235.

Smoczkiewiczowa, A. 1959. Sodium, potassium, calcium and chloride ion contents and protein fractions in the fluids of chick embryos. Nature, **183**: 1260–1261.

Tyler, C. and K. Simkiss. 1959. A study of the egg shells of ratite birds. Proc. Zool. Soc. London, **133**: 201–243.—A morphological study, using chemical and histochemical analysis and plastic embedding techniques. In physical structure

tinamou shells were closest to those of kiwis, differing greatly from those of other ratites.—E. E.

Weiss, P. and A. C. Taylor. 1960. Reconstitution of complete organs from single-cell suspensions of chick embryos in advanced stages of differentiation. Proc. Nat. Acad. Sci., **46:** 1177–1185.—"Single-cell suspensions of 8-to-14 day chick embryos transplanted to the chorio-allantoic membrane of 8-day embryos, and examined 9 days later, proved to give rise to well organized organs of the respective kinds."

## Behavior

Baeumer, E. 1959. Verhaltensstudie über das Haushuhn,—dessen Lebensart, 2. Teil. Zeitschr. für Tierpsychol., **16:** 284–296.—Three different types of fighting in chickens may be recognized: (1) fighting between adult cocks for the leading position in the territory, (2) fighting between hens for position in the hierarchy, and (3) fighting between hens and cockerels while the former are still dominant over these young males. After the ownership of different territories has been established, fights still occur at the boundaries, but do not last long and do not end in a decision but in the combatants parting in a peculiar manner, each "saving his face." A defeated cock hides his head, thus covering the red parts that obviously release attack, or goes off into complete hiding for a time in order to escape persecution by the victor. Various agonistic postures are described, including the "spiral scratching run," which is a ritualized expression of superiority. There are also observations on the return to the coop or nest, on the releasing of bathing movements, and on some peculiarities in catching live prey—W. C. D.

Coombs, C. J. F. 1960. Observations on the Rook *Corvus frugilegus* in southwest Cornwall. Ibis, **102:** 394–419.—Breeding behavior of Rooks is discussed under gonadal changes, display postures, song, copulation, pair bond, territory, nest-site selection and nest building, feeding the incubating female and the young, nest sanitation, juveniles, and relationship with other species. Some interesting points: Rooks use song posts, but song is not important in territoriality; copulation occurs most frequently between birds not paired to each other, although it is usually interfered with; in these copulations the female was incubating in more than 90 per cent of the cases; a Rook that robs a neighbor's nest for building material may establish territorial dominance over the nest.—J. W. H.

Dilger, W. C. 1960. Agonistic and social behavior of captive Redpolls. Wilson Bull., **72:** 115–132.—Displays of *Acanthis flammea* indicating submission or readiness to attack are described and illustrated. A captive flock developed a linear hierarchy with the males more dominant. When sexual behavior increased in the spring, each female became dominant over a particular male.—J. T. T.

Hess, E. H. and H. H. Schaefer. 1959. Innate behavior patterns as indicators of the "critical period." Zeitschr. für Tierpsychol., **16:** 155–172.—Experiments with Leghorn chicks indicated that a distinct color preference is shown associated with the test object to which the birds become imprinted. This color preference in descending order is: blue, red, green, orange, gray, black, yellow, and white. It was concluded that the coloring of a stimulus and its reflectance are two separate dimensions of stimulus quality, color being more important. More choices were made to the chromatic stimuli than to the achromatic stimuli. It was further concluded that the better scores during

testing of the animals that had followed the imprinting object reflected the Law of Effort in imprinting (the more effort an animal has to expend during imprinting the more completely it will be imprinted).—W. C. D.

Johnsgard, P. A. 1960. A quantitative study of sexual behavior of Mallards and Black Ducks. Wilson Bull., **72**: 133–155.—The sexual displays of male *Anas platyrhynchos* and *A. rubripes*, and the frequency and stimulation of these, are described. No qualitative differences between the displays of the two species were found, but male Black Ducks had a more sensitive response than did Mallards, presumably because of the lack of a distinctive male plumage in Black Ducks.—J. T. T.

Kunkel, P. 1959. Zum Verhalten einiger Prachtfinken (Estrildinae). Zeitschr. für Tierpsychol., **16**: 302–350.—A detailed comparative study of the behavior of 10 species of estrildine finches. Tail movements are often very different in closely related species and probably serve as signals keeping flocks together. Estrildine finches learn the edibility of objects from other birds. Pairs remain together for long periods, possibly for life; they come to know each other individually and repel newcomers; individual distance does not exist as they are "contact animals." Most of the agonistic behavior is similar to that of other small passerines, but a few species have developed special forms. Except for the Common Waxbill, Orange-cheeked Waxbill, and the Amadavat, males unceremoniously rape strange females. Song is always an expression of sexual mood but never of territorial fighting motivation. "General display" is a complete, isolated form of behavior, which is supposed to excite and synchronize the partner while the "mating courtship" invites copulation. Much more information is given, especially on behavior of the young, nest building, early reproductive behavior, and maintenance activities.—W. C. D.

Martin, E. M. and A. O. Haugen. 1960. Seasonal changes in Wood Duck roosting flight habits. Wilson Bull., **72**: 238–243.—Morning and evening roosting flights of *Aix sponsa* occurred nearer the hours of darkness and over shorter periods as the fall season advanced.—J. T. T.

Miskimen, M. 1960. Study of preroosting behavior in captive Redwing Blackbirds. Ohio Jour. Sci., **60**: 1–5.—Preroosting activity in caged Redwings is initiated by intensity of light from overhead sky with a maximum occurring between 5 and 20 f.c.; entering the roost occurred between 5 and 1 f.c. Activities increased from December through February.—H. C. S.

Orr, H. D. and T. W. Sudia. 1960. Flight distance in the Great Blue Heron. Wilson Bull., **72**: 198–199.—Distances from the observer to flushing *Ardeo herodias* under various conditions.—J. T. T.

Pennycuick, C. J. and D. Webbe. 1959. Observations on the Fulmar in Spitsbergen. Brit. Birds, **52**: 321–332.—Deals with behavior at the breeding colony (mostly calls), gliding flight (illustrated with photographs), proportions of color phases, and the departure of adults at the end of the breeding season.—F. M.

Pettingill, O. S., Jr. 1960. Crèche behavior and individual recognition in a colony of Rockhopper Penguins. Wilson Bull., **72**: 213–221.—Chicks of *Eudyptes crestatus*, studied in the Falkland Islands, cluster in crèches after about 12 days of age. Each is fed exclusively by its own parents. Protection from Skuas apparently results from the habit of gathering.—J. T. T.

Poulsen, H. 1959. Song learning in the Domestic Canary. Zeitschr. für Tierpsychol., **16:** 173–178.—The song of the Domestic Canary is not learned, but various individualistic themes can be incorporated through learning. The Canary is able to imitate frequency, rhythm, and length of a sound. This learning seems to be restricted to certain periods characterized by subsong singing. Learning also may occur in young birds during the first month of life. Imitations, once acquired, may persist for years, but also may be lost. The characteristic soft and low song of roller canaries is genetically fixed, but, as with other canaries, imitations may be included if the birds are exposed during the sensitive periods. —W. C. D.

Reinert, J. 1960. Unterscheidungsvermögen einer Dohle für verschieden schnelle Metronom-Schlagfolgen. Zeitschr. für Tierspsychol., **17:** 114–124.—In rewarded choice experiments a Jackdaw was conditioned to differentiate a series of five quick from five slower metronome beats lasting from 1.5 to 5.6 seconds. Further, the Jackdaw could at best discriminate 112 from 138 beats per minute. This is as good as has been discovered for a sheep and a chimpanzee.—W. C. D.

Strosnider, R. 1960. Polygyny and other notes on the Redwinged Blackbird. Wilson Bull., **72:** 200.—One male *Agelaius phoeniceus* defended a territory in a small marsh containing nests of four females.—J. T. T.

Suthers, R. A. 1960. Measurement of some lake-shore territories of the Song Sparrow. Wilson Bull., **72:** 232–237.—Four carefully measured territories of *Melospiza melodia* located on the edge of a lake averaged less than half an acre, intermediate in area between those reported from islands and others reported from the mainland.—J. T. T.

Tinbergen, N. 1959. Einige Gedanken über "Beschwichtigungsgebärden." Zeitschr. für Tierpsychol., **16:** 651–665.—General paper dealing with the reproductive displays of birds and other animals. Methods by which the causation and function of these displays may be determined are discussed. Agonistic displays have either a distance-decreasing or a distance-increasing function. The latter involve threat displays, and the former have to do with the inhibition of aggressive tendencies in others. Pair-formation displays often closely resemble threat displays, but both seem to have become independently ritualized with respect to the demands of pair formation. Clear traces of their original agonistic motivation are usually still visible. Comparative studies of gulls indicate that displays used at the conclusion of pair formation or greeting ceremonies have all been derived either from very "timid" threat displays or from agonistic appeasement displays. Further arguments support the validity of the previously discussed methods in tracing the evolutionary origins of smiling and laughing in Man and his relatives. —W. C. D.

Tinbergen, N. 1959. Photographic studies of some less familiar birds. C. Ruff. Brit. Birds, **52:** 302–306.—This text, accompanying photographs of *Philomachus pugnax* by C. C. Doncaster and S. Bottomley, briefly reviews the literature on communal displays, describes behavior at "leks," and interprets some of the behavior patterns in the light of knowledge on gulls and other shorebirds.—F. M.

von Frisch, O. 1959. Zur Jugendentwicklung, Brutbiologie und vergleichenden Ethologie der Limicolen. Zeitschr. für Tierpsychol., **16:** 545–583.—Behavioral observations were made on 21 species of waders and the young of 13 species hand-reared from the egg. The adult captives showed almost normal behavior

and some bred. The sound utterances of the young birds are described and evaluated. Much information on the ontogeny of behavior of these birds is given. Topics such as agonistic behavior, sexual behavior, nest building, and feeding behavior are fully treated in a comparative manner—W. C. D.

## Diseases and Parasites

Malcomson, R. O. 1960. Mallophaga from birds of North America. Wilson Bull., **72**: 182–197.—After a brief description of the methods of collecting and mounting bird ectoparasites, a list is presented of about 500 species of birds and the mallophagan species that have been recorded from each.—J. T. T.

Srivastava, B. K., H. C. Saxena, and J. C. Sharma. 1960. Influence of dietary intake of certain insecticides in the hemoglobin and erythrocyte contents of chick blood. Nature, **186**: 172–173.—DDT, Dieldrin, BHC, and malathione caused lower Hb and rbc count in all cases. The chlorinated hydrocarbons caused a continual depression and also a hock disorder similar to perosis.—H. C. S.

## Distribution and Annotated Lists

Davis, P. and R. H. Dennis. 1959. Song Sparrow at Fair Isle: a bird new to Europe. Brit. Birds, **52**: 419–421.

Drury, W. H. and M. Drury. 1959. Fulmars in the North Atlantic in the summers of 1956 and 1958. Brit. Birds, **52**: 377–383.—Counts showing distribution and color phases.—F. M.

Hickling, R. A. O. 1960. The coastal roosting of gulls in England and Wales 1955–56. Bird Study, **7**: 32–52.—Details of a winter survey.—F.M.

Johnston, R. F. 1960. Directory to the bird-life of Kansas. Univ. Kansas Mus. Nat. Hist., Misc. Publ., **23**: 1–69.—A distributional check list, with information on nests, clutch size, and egg dates. A generally useful feature is inclusion under each species of a reference to some recent monograph or paper (if available) bearing on its biology, particularly behavior.—E. E.

Loftin, H. 1960. A cooperative summering shorebird survey. Florida Nat., **33**: 199–208.—Fifteen species of shorebirds were noted in Florida during June 1959. Localities, dates, and number of each are given, and in some cases the apparent plumage. Many of the species were present in numbers throughout the month; others may have been late stragglers on migration northward.—E. E.

McKinley, D. 1960. The Carolina Parakeet in pioneer Missouri. Wilson Bull., **72**: 274–287.—The recorded history of *Conuropsis carolinenses* in Missouri is summarized, with many quotations from the original sources.—J. T. T.

North, M. E. W. 1959. The great heronry of Garson on the Tana River. Jour. E. Afr. Nat. Hist. Soc. **23**: 159–160.—Thirteen species of herons and ibises breeding at Garson, Kenya Colony.—H. F.

Parsons, B. 1959. Some Makueni birds. Jour. E. Afr. Nat. Hist. Soc. **23**: 164–166.—List of common birds in the highlands 90 miles from Nairobi, Kenya Colony.—H. F.

Sharrock, J. T. R. and R. Gillmor. 1959. Ring-necked Duck in Berkshire. Brit. Birds, **52**: 427–430.—The third European and second British record.

Taverner, J. H. 1959. The spread of the Eider in Great Britain. Brit. Birds, **52:** 245–258.—Increase in numbers and extension of breeding range began about 100 years ago. In recent years, wintering range has been extended greatly; now almost all coasts of England have wintering Eiders.—F. M.

Wagner, H. O. 1959. Die Einwanderung des Haussperlings in Mexiko. Zeitschr. für Tierpsychol., **16:** 584–592.—About 1910 House Sparrows *(Passer domesticus)* immigrated to Mexico simultaneously from the northeast and along the Pacific coast. Environmental influences stopped the advance in the region of the Gulf and considerably impeded it in the uplands. Along the Pacific coast the birds advanced at a rate of about 200 km. a year until they reached the Isthmus of Tehuantepec; they followed the valleys of the rivers Lerma and Balsas into the inner parts of the country. The southern part of the Gulf coast is inhabited by sparrows that came across the continent. These birds are apparently able to cross dry areas if the drought is not exceptionally severe and if there are a few human settlements on the way. Very arid areas and virgin forests both uninhabited by humans serve as ecological barriers. High temperatures inhibit or prevent immigration. Occasional periods of very high temperature diminish the population or even eliminate it. Such regions, however, seem to be constantly reinhabited. Yearly recurring maximum temperatures of above 40° C prevent permanent colonization. The worse conditions are, within supportability, the quicker the birds tend to spread. Young birds are probably the chief source of colonizers, but these are not driven away by adults nor by lack of territorial space. During this time they are simply nomadic and tend to colonize anyway. Environmental factors like landscape configuration or vegetation character may influence their course.—W. C. D.

Winterbottom, J. M. 1960. The zoo-geographical affinities of the Western Cape Province. Ibis, **102:** 383–393.—There are three avifaunal divisions in this region: winter-rainfall area (south-coastal), temperate forest (patches in western Cape), and karoo (arid inland and eastern Cape). The author briefly describes the botany and history of these areas; their relations to the avifauna are discussed in terms of ecology, zoogeography, and evolution.—J. W. H.

## Ecology and Population

Beals, E. 1960. Forest bird communities in the Apostle Islands of Wisconsin. Wilson Bull., **72:** 156–181.—The bird populations of 24 stands of forest on islands in Lake Superior were estimated by a sample count method. An objective method of measuring similarity of bird species and of vegetation between stands was used as the basis for drawing conclusions about the environmental distribution and habitat preference of the bird species.—J. T. T.

Cole, L. C. 1960. Competitive exclusion. Science, **132:** 348–349.—"It is contended that there is little justification for believing in the competitive exclusion principle ["Gause's hypothesis"] as usually formulated. There is danger that a trite maxim like this may lead to the neglect of important evidence." (Author's abstract.)

Coulson, J. C. 1959. The plumage and leg colour of the Kittiwake and comments on the non-breeding population. Brit. Birds, **52:** 189–196.

Enderson, J. H. 1960. A population study of the Sparrow Hawk in east-central Illinois. Wilson Bull., **72:** 222–231.—By censusing and marking individuals of

*Falco sparverius*, the wintering, transient, and breeding populations were estimated, and the home ranges of some individuals were determined.—J. T. T.

Finnis, R. G. 1960. Road casualties among birds. Bird Study, **7**: 21–32.—Casualties on British, French, and American roads are compared; the kill is greater on British roads, with their frequent changes of direction and close cover. The high mortalities of House Sparrow, Blackbird, and Song Thrush are discussed in detail.—F. M.

Norris, C. A. 1960. The breeding distribution of thirty bird species in 1952. Bird Study, **7**: 129–184.—Results of an attempt to map the approximate numerical status of 30 species (mostly passerine) in the British Isles.—F. M.

Royama, T. 1960. The theory and practice of line transects in animal ecology by means of visual and auditory recognition. Misc. Reports of the Yamashina's Inst. for Ornith. and Zool., **2** (14): 1–17.—Reviews practical and mathematical aspects of line transects. An actual comparison of woodland bird populations as estimated by census and line transect techniques showed serious discrepancies, which are ascribed to variability in conspicuousness of the birds being counted. An appendix gives the mathematics underlying the theories. (In English.)—K. C. P.

Williams, G. R. 1960. A preliminary account of a regular fluctuation in California Quail in Central Otego [New Zealand]. Proc. N.Z. Ecol. Soc., **7**: 9–11. On South Island, New Zealand, the introduced *Lophortyx californicus* shows a four-year cycle, with the year of maximum increase immediately following the "low" of the preceding three years.—E. E.

## General Biology

Baker, J. K. 1960. The Cave Swallow. NSS News, National Speleological Soc. **18**: 72.—Brief abstract of paper presented at 1960 Convention, outlining known information on U.S. range.

Clase, H. J., F. Cooke, T. A. Hill, and W. J. Roff. 1960. A survey of the Slavonian Grebe at Myvatn, Iceland. Bird Study, **7**: 76–81.—Information on population, clutch size, nest-site preference, nest materials, and colonies of *Podiceps auritus*. —F. M.

Elgood, J. H. and P. Ward. 1960. The nesting of Heuglin's Masked Weaver in Nigeria. Ibis, **102**: 472–473.—The Masked Weaver is recorded as nesting in association with some other kind of animal in five of six observations (with wasps, bees, storks, and man). The species may not be fundamentally a social nester, but rather its tendency to nest in groups may be the result of several pair seeking a common "protector."—J. W. H.

Heyder, R. 1960. Zur Aufnahme von Mineralsalzen durch Vögel. Beitr. Vogelk., **7**: 1–6.—Comments on eating of salt by birds.—E. E.

Kanai, I. 1960. Breeding ecology of the House Swallow, *Hirundo rustica*. Misc. Reports of the Yamashina's Inst. for Ornith. and Zool., **2** (14): 30–40.—Figures for the Tokyo region based on a three-year study of several hundred nests (dates of arrival, building, laying, hatching and fledging, incubation period, clutch size, brood size, per cent hatching and fledging, growth of young, banding results). (In Japanese with English summary.)—K. C. P.

Koffán, K. 1960. Observations on the nesting of the Woodlark (*Lullula arborea* L.). Acta. Zool. Acad. Sci. Hung., **5**: 371–412.—A thorough study of a color-marked population on an area about six km. square near the Hungarian capital was carried out over a period of more than 10 years. The area is arid pasture land with calcareous rocks and many gullies. Vegetation is sparse, mostly grasses and trees. The following topics are considered: nest sites, concealment of nests, nesting in cultivated areas, direction in which nests face (mostly north), elevation, nest-site selection (by the male), territory, relationship of nest hollows to soil properties, the number of hollows and their excavation, removal of excavated materials (including experiments with empty snail shells), nest building, nesting period, effects of weather, associations with other birds. A well-prepared paper (in English) with 24 references cited.—F. J. T.

Kuroda, N. 1960. Field studies on the Grey Starling, *Sturnus cineraceus* Temminck. 3. Roosting behaviour from summer to autumn (1. Observation in the east of Tokyo, with note on feeding behaviour). Misc. Reports of the Yamashina's Inst. for Ornith. and Zool., **2** (14): 18–29.—Factors governing choice of roosts during and after breeding are reviewed, together with factors stimulating change of roost site. In autumn sparrows and starlings gather together at rice paddies, but eat different foods. Starlings favor rice worms found on cut stems. (In Japanese; tables, captions to figures, and summary in English.)—K. C. P.

Lockie, J. D. 1959. The food of nestling Rooks near Oxford. Brit. Birds, **52**: 332–334.

Marchant, S. 1960. The breeding of some S.W. Ecuadorian birds. Ibis, **102**: 349–382.—Includes data on nest site, nest, eggs, laying, incubation, nestling period, breeding success, and breeding season for 33 species (Tinamous through Vireos). To be concluded in a later issue.—J. W. H.

Nau, B. S. 1960. Late nest-building of the Rook. Bird Study, **7**: 185–188.—Two periods of nest-building activity, separated by an interval of three weeks, were noted. It is suggested that inexperienced breeders nest later.—F. M.

Newton, I. 1960. The diet and feeding habits of the Bullfinch. Bird Study, **7**: 1–9.—On the basis of sight observations, diet of *Pyrrhula pyrrhula* can be broadly divided according to season: buds in spring, insects in early summer, berries in autumn, and seeds during late summer and winter. Details of food and methods of obtaining it are given.—F. M.

Niess, H. 1960. Brütet das Männchen vom Höckerschwan, *Cygnus olor* Gm., wirklich? Beitr. Vogelk., **7**: 19–21.—Gives evidence suggesting that male of Mute Swan does not really incubate, but merely sits on the eggs to guard them when female is away.—E. E.

Peakall, D. B. 1960. Nest records of the Yellowhammer. Bird Study, **7**: 84–102.—An analysis of nest record cards for *Emberiza citrinella* deals with geographical variation in breeding season, clutch size, incubation and fledging periods, nest sites, and breeding success. A new method for calculating breeding success from these cards is described in an appendix.—F. M.

Phillips, A. 1960. A note on the ecology of the Fairy Penguin, *Eudyptula minor novaehollandiae* (Forster 1781) in southern Tasmania. Papers and Proc. Roy. Soc. Tasmania, **94**: 63–72.—A preliminary report. Two types of breeding grounds, on rocky and sandy coasts, are being studied. An aluminum flipper band has proved unsatisfactory, and an improved stainless steel band is now being

tried. Chicks are marked by punching webs. Methods for external sexing of *Eudyptula* penguins are reviewed. Tables of measurements illustrate sex differences.—K. C. P.

Rand, R. W. 1960. The biology of guano-producing sea-birds. 3. The distribution, abundance and feeding habits of the cormorants Phalacrocoracidae off the south west coast of Cape Province. Dept. Comm. and Indust., Div. Fish. Inv. Rept., **42**: 1–32.—Union of South Africa.

Ripley, S. D. 1960. Laysan Teal in captivity. Wilson Bull., **72**: 244–247.—The nesting, eggs, downy young, and development of *Anas laysanensis* are described and a duckling is figured.—J. T. T.

Royama, T. 1959. Test of an automatic nest-recorder. Brit. Birds, **52**: 295–302.—By use of an iron detector, a recorder attached to a nesting box gave separate records for male and female visits, only one member of the pair having iron leg bands. Results are presented for a pair of Great Tits in Japan.—F. M.

Uramoto, M. and S. Takano. 1960. Bird research at Musahi Imperial Tomb area (Occasional Report I). Breeding success of Great Tit, *Parus major*, in 1959. Misc. Reports of the Yamashina's Inst. for Ornith. and Zool., **2** (14): 60–62.—Of 26 nests initiated (in nest boxes), clutches were completed in 10. Only one nest fledged young successfully. (In Japanese with English summary.) —K. C. P.

Wagner, H. O. 1959. Nestplatzwahl und den Nestbau auslösende Reize bei einigen mexikanischen Vogelarten. Zeitschr. für Tierpsychol., **16**: 297–307.—Describes the nest site of the Blue-throated Hummingbird (*Lampornis clemenciae*)—alaways in places sheltered from the rain such as washed-out banks, overhanging cliffs, or under roofs. In some icterids and hummingbird species (providing that they are in reproductive condition) the breeding season starts as soon as they are able to find wet moss and/or flexible strands of grass that usually signal the beginning of the rainy season. Following the eruption of a volcano, Cliff Swallows *(Petrochelidon pyrrhonata)* stayed in their lava-surrounded nesting localities as long as the old nests would hold together, as new wet earth for repairs was unobtainable. House Finches *(Carpodacus mexicanus)* nesting on the ruins of houses amidst the cinders lost their broods for lack of food. Kingbirds *(Tyrannus melancholicus)*, although in breeding condition, could not nest for lack of fresh grass strands.—W. C. D.

Williamson, K. 1960. The development of young Snipe studied by mist-netting. Bird Study, **7**: 63–76.—A study on St. Kilda, Outer Hebrides, gave information on breeding season, clutch size, division of parental responsibility, distraction display, development of young, plumage and soft-part colors, molt, measurements and weights of adults, and ectoparasites for *Capella gallinago faeroeensis*.—F. M.

## Migration and Orientation

Andrew, D. G. 1959. Migrations of the Oystercatcher. Brit. Birds, **52**: 216–220.—Conclusions drawn from banding returns and observations of birds on passage. —F. M.

Goodacre, M. J. 1960. The origin of winter visitors to the British Isles. 5. Redwing *(Turdus musicus)*. Bird Study, **7**: 102–107; 6. Song Thrush *(Turdus philomelos)*. Bird Study, **7**: 108–110; 7. Fieldfare *(Turdus pilaris)*. Bird Study, **7**: 111–113.

Graber, R. R. and W. W. Cochran. 1960. Evaluation of an aural record of nocturnal migration. Wilson Bull., **72**: 253–273.—Records on tape of the calls of nocturnal migrants were analyzed in various ways. A favorable, following wind apparently exerts the dominant influence in the start of a mass flight; a shift of wind to an opposing direction may halt a flight. Migrations frequently were initiated and continued under complete overcast. Comparisons were made between data acquired by this method and information obtained from lunar observations, field observations, and kills of migrants at towers.—J. T. T.

Harrison, T. 1960. Regularity of migrant dates in central Borneo. Ibis, **102**: 472.—Eight species of birds are shown to have markedly regular arrival dates in upland interior Borneo. Arrivals of four of these species, *Motacilla flava, Lanius cristatus, Accipiter virgatus,* and *Turdus obscurus,* are used by natives to set their calendar.—J. W. H.

Lack, D. 1959. Watching migration by radar. Brit. Birds, **52**: 258–267.—Reviews the history of bird detection by radar and the conclusions drawn from recent studies on migrations over eastern England.—F. M.

McLean, I. and K. Williamson. 1959. Migration notes from the Western Approaches, spring 1958. Brit. Birds, **52**: 177–185.

Moreau, R. E. 1960. Autumn migrants in Greece. Ibis, **102**: 473–475.

Murton, R. K. 1959. Visible migration in N.E. Norfolk in November 1956. Brit. Birds, **52**: 228–235.

Nisbet, I. C. T. 1959. Wader migration in North America and its relation to transatlantic crossings. Brit. Birds, **52**: 205–215.—"The relative frequency of occurrence of various American waders in Great Britain is compared with the available information on their migration patterns and abundance in North America. Some species which have occurred in Britain are rare on the American coast, while there are especially few British records of the species which are most abundant there. Species of inland habitat are relatively more frequent than those of the coast; long-distance migrants are more frequent than short-distance migrants; and species from western arctic America are much more frequent than species from eastern arctic America. Transatlantic vagrancy occurs mainly in those species in which a part of the population has an extensive west-to east movement within North America. Spring records in Britain bear still less relation to the relative abundance of the species concerned in eastern North America. It is suggested that the birds have either wintered in the Old World or crossed from South America to Africa on spring migration. Similar conclusions apply in reverse to the records of European waders in eastern North America." (Author's summary.)

Nisbet, I. C. T. 1959. Bewick's Swans in the British Isles in the winters of 1954-55 and 1955-56. Brit. Birds, **52**: 393–416.—Documents two large invasions with notes on status in the past, migratory behavior, habitat, feeding, age composition, and mortality. In February 1956 about 4,400 birds left Germany and the Netherlands and flew west to Great Britain; this movement coincided with a long period of severe frost.—F. M.

Radford, M. C. 1960. Common Gull movements shown by ringing returns. Bird Study, **7**: 81–93.—Analysis of returns of birds banded in the British Isles and those banded abroad that were recovered in the British Isles.—F. M.

Swinebroad, J. 1960. A review of some problems in the study of bird migration. Ohio Jour. Sci., **60**: 174–182.—The use of influx and departure data to help answer some problems arising from a critical approach to migration studies in the field.—H. C. S.

Wallraff, H. G. 1959. Über den Einfluss der Erfahrung auf das Heimfindevermögen von Brieftauben. Zeitschr. für Tierpsychol., **16**: 424–444.—More than 2,000 carrier pigeons were used to determine the effects of prior homing experience on homing behavior. With the number of previous flights, the homing success increases rapidly at first but more slowly later. The increase of performance was mainly in speed but also in lessened losses of birds. Selection is probably also important, as poor homers tend to become lost on one of the early flights. Increase in speed is due to learning. Special knowledge of the release point is of much less importance than is homing experience in general. Other results are also given.—W. C. D.

Wallraff, H. G. 1959. Örtlich und zeitlich bedingte Variabilität des Heimkehrverhaltens von Brieftauben. Zeitschr. für Tierpsychol., **16**: 513–544.—More than 3,000 birds were used to evaluate temporal and other factors on the homing abilities of carrier pigeons. Four criteria were used to judge performance: (1) time in sight, (2) initial direction taken, (3) homing performance, (4) reports on birds gone astray. In general, after 20 seconds the birds showed a definite tendency to head homeward. Initial orientation and homing performance are positively correlated. Initial headings and homing performance may differ at different release points. Excellence of homi:.g shows an annual cycle, maximum in August and minimum in January. Initial orientation and homing performance may vary from day to day, even at the same release point; weather conditions alone do not explain the observed results. Hour-to-hour variation also occurs (not periodical and not associated with weather changes). At one release point, the initial orientation data obtained in 1957 varied from that obtained in 1954-56. It is further concluded that the demonstration of local and temporal variations in homing behavior shows (supplementary to other findings) that visual landscape orientation and celestial orientation are not sufficient to explain the homing ability.—W. C. D.

Wallraff, H. G. 1960. Über Zusammenhänge des Heimkehrverhaltens von Brieftauben mit meteorologischen und geophysikalischen Faktoren. Zeitschr. für Tierpsychol., **17**: 82–113.—Investigations were made to determine the effects of wind, cloud cover, fog, air temperature, barometric pressure, and sun-spot activity on the homing ability of carrier pigeons. Wind influenced initial heading and homing performance, but the influence is small with light winds, and the effects may be ignored. Cloud cover has little influence, unless the sun is obscured. Data suggest that the pigeons can locate the sun after the human eye is no longer able to do so. Visibility shows a loose connection to homing performance, but only very poor visibility (fog) has a decisive influence. Apparently there is a question whether the poor visibility itself is the decisive factor or whether atmospheric conditions coincident with fog are affecting the performance. Air temperature is of little importance. Interdiurnal variations in barometric pressure at higher altitudes have a significant effect on homing ability, performances being poorer during periods of rising pressure. Sun-spot activity could not be proved to be a significant variable, but the results do not exclude any connection.—W. C. D.

Williamson, K. 1959. The September drift-movements of 1956 and 1958. Brit. Birds, **52**: 334–377.—Describes and compares drift movements on the east coast of

England for the two years. Eastern and southern vagrants from Europe were recorded in unusual numbers in 1958. The bird records are correlated with weather conditions, and the evidence for down-wind drift is presented. Vagrants were predominantly young of the year. It is suggested that the orientation mechanism does not mature until after a brief phase of postjuvenile dispersal. Light easterly winds in 1958 produced a drift-aided dispersal far to the west of the normal range.—F. M.

## Physiology

Boyer, G. 1960. Chorioallantoic membrane lesions produced by inoculation of adult fowl leucocytes. Nature, **185:** 327–328.

Braekkan, O. R., H. Myklestad, L. R. Njaa, and F. Utne. 1960. Vitamin A isomers in the liver of rats and chicks. Nature, **186:** 312.

Fussell, M. H. 1960. Collection of urine and faeces from the chicken. Nature, **185:** 332–333.—A surgical technique for separating urine and feces by exteriorizing the large intestine.—H. C. S.

Kornfeld, W. 1960. Experimentally induced proliferation of the rudimentary gonad of an intact domestic fowl. Nature, **185:** 320.—Brought about by injecting anti-estrogenic 17 α-ethyl-19-nortestosterone.—H. C. S.

Wilkie, D. R. 1959. The work output of animals: flight by birds and by man-power. Nature, **183:** 1515–1516.

## Taxonomy and Palaeontology

Gilliard, E. T. 1960. Results of the 1958-1959 Gilliard New Britain Expedition. 2. A new species of ticket warbler (Aves, *Cichlornis)* from New Britain. Amer. Mus. Novitates, **2008:** 6 pp.—*Cichlornis grosvenori,* based on two specimens from Wild Dog Range, Whiteman Mts., New Britain, 5,200+ feet elevation. The only other species of this little-known genus is *C. whitneyi,* of which five specimens have been taken on Espiritu Santo, New Hebrides, and one *(C. w. turipavae)* on Guadalcanal, British Solomon Islands. These elusive forest birds may yet be found on other high islands of the Pacific.—K. C. P.

Mainardi, D. 1960. Dati di ibridologia per una sistematica dei fringilidi. Inst. Lombardo (Rend. Sc.) B., **94:** 43–62.—Using data in Gray's "Bird Hybrids" (1958), relations between the subfamilies of Fringillidae and allied families are analyzed. *Fringilla* is definitely known to have hybridized with several carduelines, but not with any emberizine; the view that it is emberizine seems to be negatived. The carduelines occupy a central position hybridologically, for carduelines have occasionally produced hybrids with *Emberiza,* and even with *Passerina* (considered, depending on the authority, either richmondenine or emberizine). The North American cardinal, *Richmondena,* has hybridized with the South American cardinals *Paroaria* and *Gubernatrix* (which Tordoff removed from the richmondenines to the emberizines because of differences in palato-maxillaries). Even the estrildine *Lonchura* (Ploceidae) is reported to have hybridized with the cardueline *Serinus,* as well as with the neotropical *Tiaris* (considered emberizine or richmondenine by recent writers). Mainardi points out that the hybrid data suggest close relationship among the subfamilies traditionally included in Fringillidae; at least they indicate that the proposed dismemberment of that family is premature. There is some support for the view that the Ploceidae, or at any rate some genera allocated to that family, might be included in the family Fringillidae. (In Italian; English summary.)—E. E.

Milne, B. S. 1959. Variation in a population of Yellow Wagtails. Brit. Birds, **52**: 281–295.—Results of field work and color banding, over a period of three years in Surrey, support the suggestion (previously based only on museum taxonomy) that the grayish-headed races should be regarded as a distinct species from the yellow-headed races. *"Budytes perconfusus"* is thought to be an interspecific hybrid. Enormous variation found in this group in southeast England is thought to be due to interspecific hybridization, rather than the result of gene flow from "drifted" migrants.—F. M.

Moreau, R. E. 1960. Conspectus and classification of the Ploceine Weaver-birds. Ibis, **102**: 443–471.—A continuation of a paper begun earlier in the *Ibis*. Under his Group A Ploceinae the author continues discussion considering nests and nest sites, eggs and clutch sizes, food and beaks, size and proportions, and classification. There follow a brief discussion of Group B Ploceinae and a general section divided into a discussion of ploceine geography, intraspecific variation, and conclusions. A major attempt at systematic organization of an avian taxon, relying not only on morphological characters but upon a thorough consideration of existing knowledge on behavior, breeding biology, and zoogeography as well.—J. W. M.

Morioka, H. 1960. The skull of *Regulus regulus*, with some remarks on the taxonomic status of Regulidae. Mem. Coll. Sci., Univ. Kyoto, Ser. B, **27**, No. 1: 59–64.—On the basis of comparison of the skull of *R. regulus* with those of certain characteristic genera of Sylviinae, the writer concludes that the relations between the kinglets and Old World warblers may not be so close as has been assumed.—E. E.

Patterson, B. and J. L. Kraglievich. 1960. Sistemática y Nomenclatura de las Aves Fororracoideas del Plioceno Argentino. Publ. Mus. Muncipal Cienc. Nat. y Tradicional Mar del Plata Argentina. Vol. **1**, No. 1: 1–49.—A much-needed revision of the Pliocene phororhacoids. The Phororhacoidea are considered a superfamily of the Cariamae and are divided into three families: the Psilopteridae (with the subfamilies Psilopterinae and Hermosiornithinae), the Phororchacidae (with the subfamilies Phororhacinae and Tolmodinae), and the Brontornithidae. *Opisthodactylus* is referred to the Rheidae; and the Cunampaiidae are not included in the Phororhacoidea. A new tolmodine genus, *Andalgalornis*, is described. (In Spanish, with English summary.)—R. W. S.

Taylor, D. W. 1960. Late Cenozoic molluscan faunas from the High Plains. Geol. Surv. Prof. Pap. **337**: 1–94.—Data from fossil mollusks clearly support those from mammals in assignment of Rexroad local faunas in Meade County, Kansas, to Upper Pliocene. Seven species of birds reported from these beds, which include the Mourning Dove and turkey, are verified as of Upper Pliocene age.

## Miscellaneous

Lack, D. 1960. Hints on research for bird-watchers. Bird Study, **7**: 9–20.—A valuable discussion written for those amateur bird watchers who want to do scientific research. The author has spent 31 years carrying out, directing, encouraging, and publishing research on birds. His conclusions on the nature of research, choice of subjects, desirable qualities in the researcher, and procedure of writing up results will be of interest and value to both amateur and professional ornithologists.—F. M.

## NOTES AND NEWS

The Josselyn Van Tyne Memorial Fund will have a sum of $300 available for research awards at the end of the fiscal year, 31 July 1961. Any student of birds is invited to apply for part or all of this amount.

Ten duplicate copies of applications are desired for distribution to members of the Research Committee, who will determine how the funds will be allotted. The application should give a full description of the proposed research, the type of help required (equipment, travel, assistance, etc.), the amount of money desired, and the background and training of the applicant. With young men or women just starting their careers, a supporting letter from one or more recognized ornithologists would be helpful.

Applications should be submitted not later than 1 June 1961 to S. C. Kendeigh, Chairman, Vivarium Building, University of Illinois, Wright and Healey Sts., Champaign, Illinois.

The Thirteenth International Ornithological Congress will be held at Cornell University, Ithaca, New York, U.S.A., from 17 to 21 June 1962. The President is Professor Ernst Mayr.

The International Ornithological Congresses are scientific meetings that have been held at intervals since 1884. Since 1926 a four-year cycle has been maintained, except for a 12-year interruption caused by World War II. The previous Congresses have been held in continental Europe and England.

Persons wishing to receive further announcements and membership application forms for the Thirteenth International Ornithological Congress should send their names and permanent mailing address to the Secretary-General, Professor C. G. Sibley, Fernow Hall, Cornell University, Ithaca, New York, U.S.A., before 1 February 1962.

Awards for ornithological research are made in April of each year by the Frank M. Chapman Memorial Fund Committee of the American Museum of Natural History, New York. Applications should be received by 1 March.

## CORRESPONDENCE

### Northern Migrant Wintering in Tropics

An interesting note in a recent number (Snow and Snow, *Auk*, 77: 351–352, 1960) reports a banded Northern Waterthrush present at the same locality in Trinidad in two successive winters, and suggests that this may be the first such record for a northern migrant wintering in the tropics. At least one other is in the American literature, an instance involving the return of banded Indigo Buntings to a jungle clearing at Uaxactun, Petén, Guatemala (Van Tyne, *Bird-Banding*, 3: 110, 1932; Van Type, U. Mich. Mus. Zool. Misc. Publ., No. 27, p. 43, 1935; Van Tyne and Berger, *Fundamentals of Ornithology*, p. 208, 1958). Meinertzhagen (*Birds of Arabia*, p. 39 and p. 588, 1954) mentions examples of return in successive years to identical wintering localities in tropical Africa and India by banded *Calidris temminckii* and *Motacilla cinerea* (five successive winters) and a belled Peregrine Falcon.—WILLIAM B. ROBERTSON, JR., *Field Research Biologist, Region One, National Park Service, Homestead, Florida.*

## OBITUARY

RAYMOND GANO GUERNSEY became an Associate Member of the Union in 1928 and a Patron in 1955. He was born in Poughkeepsie, New York, 21 August 1878, and died there on 19 May 1959.

A bachelor, he was educated at Exeter Academy in New Hampshire, Yale University (class of 1902), and New York University Law School. He taught a year at Westminster School in Connecticut, practiced law for several years in New York City, then returned to Poughkeepsie as partner in his father's firm and practiced law there the rest of his life. Ray's interest in birds, especially in Dutchess County, was lifelong. He was afield most frequently during the active period of Maunsell Crosby and Allen Frost, the trio often joined by Ludlow Griscom. An especially memorable incident occurred at a crucial time early in World War II, when another county resident with a lifelong ornithological interest —Franklin D. Roosevelt—went "birding" with Guernsey, Frost, Griscom, and a sizable squad of FBI agents to guard the President. A guard, on being awakened for duty about 4 A.M., said of the President: "What in hell is he up to at this time in the morning?" It was an enjoyable trip, with visits to favorite localities that did not all survive encroachment of expanding industrial development during Ray's lifetime.

He was a trustee and treasurer of Vassar College; any faculty member could count on him for gratis legal assistance. He was a very active supporter of the church, a number of charities, and a variety of other organizations. The extent of his frequent and quiet generosity toward these never was known even by his closest associates.—RALPH S. PALMER.

# THE AUK

## A Quarterly Journal of Ornithology

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For publication in 'The Auk,' articles or notes must present material that is of significance to ornithologists and that has not been published elsewhere. All manuscripts should be typewritten, double spaced, with wide margins. Titles should be brief. Terminal bibliographies are used as a rule for long articles. Only works actually cited in the text are to be included in these bibliographies; works not so cited will be deleted by the editors. Where fewer than five references to literature are made, they may be inserted in parentheses in the text. References in manuscript for 'General Notes' should be in the text. Consult issues of 'The Auk' since January, 1949, for style of citation. Long articles should be summarized briefly. Footnotes, Roman numerals, and ruled tables are to be avoided. Acknowledgments belong in the text. Line drawings must be in India ink on white paper or drawing board; usually these should be planned for at least one-half reduction when printed. Thus, details and lettering must be correspondingly large. Legends must be brief. Photographs must be hard, glossy prints of good contrast. Common and scientific names of North American birds should follow the A.O.U. Check-List (Fifth Edition), except in taxonomic papers giving critical discussions and in justified special cases.

Proofs of all articles and notes will be sent to authors. Reprints from articles, notes, and other items are to be paid for by the author. These must be ordered from the Editor on the blanks sent with the proof and must be returned with the proof. Printed covers can be furnished at additional cost.

All articles and notes submitted for publication and all books and publications intended for review should be sent to the Editor:

DONALD S FARNER, *Department of Zoology, Washington State University, Pullman, Washington.*

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